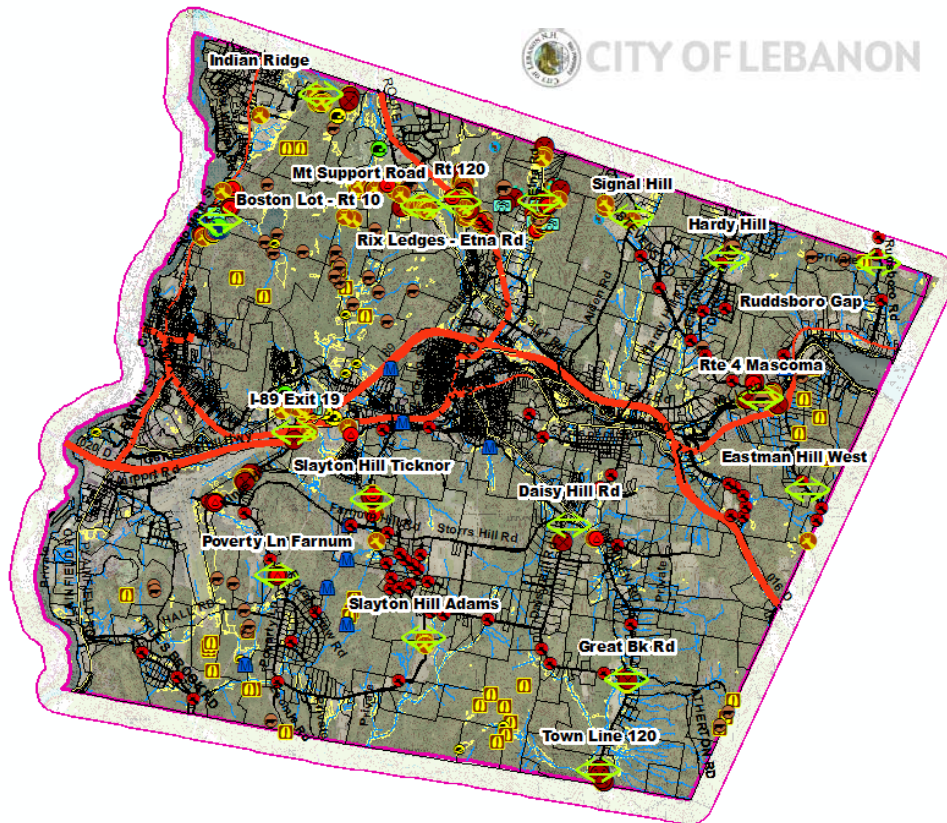


# *Lebanon's Wildlife Corridors*

Results of a  
WILDLIFE CORRIDOR ANALYSIS  
Of the  
City of Lebanon, NH



Prepared for the  
LEBANON PLANNING DEPARTMENT

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## **Foreward**

In December of 2004, Lebanon completed a Phase I Natural Resources Inventory. The Phase I work was one of the first steps in what the 2002-2006 Master Plan stated as “bringing about a more refreshed ecology” in Lebanon. In 2010, Phase II of Lebanon’s Natural Resource Inventory or NRI, was completed. The final report, “Natural Lebanon,” can be found on the City’s web site at <http://planning.lebnh.net/home/documents/nri>. In that document, 65 wildlife crossing areas were identified that contained potential significance for upland and wetland mammals and game birds. In 2013, Dr. Alcott Smith and the author completed a wildlife corridor assessment of three of these locales in Lebanon that were subject to development and road construction that could impact their viability as wildlife crossing areas. This report is on file at the City’s Planning Department. In 2014, the City Planning Department commissioned the author to conduct an analysis of the remainder of the major wildlife crossing areas to determine a) how they were being used, b) which species of concern were using them, and c) what, if anything, could be done to improve their potential for passage. This report summarizes those findings.

While researching the history of use of these wildlife crossings areas, it was apparent that the “green infrastructure” of the City has become more and more important as zoning changes, development projects and impacts to the city’s natural landscape have occurred. Projects such as the Timberwood Development on Mount Support Road and the Element Hotel along Route 120 have effectively “pinched” potential crossing areas into smaller and smaller belts of green. Unfragmented blocks of land such as those on either side of Interstate I-89 have been isolated as road networks have built up physical barriers to wildlife. The Planning Department wished to identify not only the areas that were currently being put under pressure, but also those sites where future growth impacts could be offset by reasonable protections to allow native wildlife the ability to maintain their travel corridors between unfragmented lands.

This latest study study focused on 14 wildlife corridor areas in addition to the three that were previously assessed with Dr. Alcott Smith (I-89 at Exit 19; upper Mount Support Rd; and Route 120). These corridor areas were selected from the initial 65 crossing sites by Mark Goodwin of the Planning Department, who used GIS data to filter out the most critical areas for review. The resultant 14 areas were then subjected to additional GIS review and subsequent fieldwork.

This report maps and describes each of these 17 wildlife corridor areas, and provides recommendations for all areas relative to improving their long-term viability for wildlife passage. Recommendations generally include signage, improved overpass or underpass structures, land conservation measures, and targeted monitoring. The results of this report are intended to be integrated into short and long-term planning that promotes the ‘green infrastructure’ in Lebanon in order to enhance the quality of life for wildlife species in the city.

## **ACKNOWLEDGMENTS**

The author would like to thank the staff at the Lebanon Planning Department, particularly former City Planning Director Andrew Gast-Bray, and now current City Planning and Zoning Director David Brooks, GIS Coordinator Mark Goodwin, and Dr. Alcott Smith. This report is dedicated in memorium to two remarkable wildlife advocates and enthusiasts, Nicole Cormen and John Jolene, whose love of nature continues to inspire those of us lucky enough to observe and help protect it.

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## **Lebanon Wildlife Corridor Assessment Project Report**

**Submitted to the Lebanon Planning Department**

**November 30, 2016 - R. Van de Poll**

### **I. Background**

#### 2013-2014 Study

In 2013-2014, the Wildlife Corridor Assessment Project was focused on three of the 65 areas that had been identified as wildlife crossing sites during the 2008-09 NRI project. These three sites were areas where the City had determined that future development may impede or prevent wildlife corridor potential, namely, Interstate 89 at the base of Poverty Lane, the Mt. Support Road area, and Route 120 near the new Altaria development behind the former Wilson Tire Company.

The 2013-2014 study recorded deer, coyote, red fox, gray fox, ermine, fisher, mink, black bear, beaver, raccoon, skunk, and porcupine. The more wide-ranging animals such as deer, bear, and coyote provided a more significant record of wildlife corridor use among larger unfragmented lands, yet the use of adjacent wetland areas by smaller mammal species was not insignificant in representing the value of Lebanon's "green infrastructure."

#### 2015-2016 Study

The purpose of the most recent Wildlife Corridor Study has been to further assess habitat availability for these short and long migrant wildlife species in order to better understand the value of selected areas of Lebanon, particularly in light of several proposed development projects before the Planning Board. An in-depth evaluation of the following 14 crossing areas has been underway since March of 2015:

- A. Indian Ridge**
- B. Boston Lot / Route 10**
- C. Rix Ledges / Etna Road**
- D. Signal Hill**
- E. Hardy Hill**
- F. Ruddsboro Gap**
- G. Route 4 / Mascoma River**
- H. Eastman Hill West**
- I. Daisy Hill Road**
- J. Great Brook / Meriden Road**
- K. Plainfield Town Line / Route 120 South**
- L. Slayton Hill / Adams**
- M. Poverty Lane / Farnum Hill**
- N. Slayton Hill Road / Ticknor**

#### Methods

Each crossing area was preliminarily reviewed with Mark Goodwin of the Lebanon Planning Department using desktop GIS tools. Critical remote data sources for this review included the following data layers:

<u>Resource Layer</u>	<u>Date</u>	<u>Description</u>
Active Agricultural Areas*	2010	Ecosystem Management Consultants
API <sup>1</sup> Land Cover Mapping	2014	Mark Goodwin, Lebanon Planning Dept.
API Wetland Mapping*	2010	Ecosystem Management Consultants
API Wildlife Habitat Mapping*	2009	Ecosystem Management Consultants
2-foot Contours	2009	Lebanon Planning Dept.
Culverts	2009	City of Lebanon DPW
Deer yards*	2009	Ecosystem Management Consultants
Digital Elevation Models	1987	From USGS topographic sources
Digital Orthophoto Quads (DOQ)	1998	Historical aerial photo data
Digital Raster Graphics (DRG)	1987	USGS topographic maps
Landsat land use coverage	2001	Latest satellite imagery of cover types
NAIP <sup>2</sup> aerial photography	2003,9	Statewide coverage of leaf-on condition
NH Hydrography Dataset	2010	Streams & rivers, and other surface waters
NH Wildlife Action Plan (WAP)	2015	Wildlife habitat & condition ranking
Parcel Map for Lebanon	2013	Lebanon Planning Department
Political boundaries	1996	UNH CSRC
Public Roads	2013	NH DOT
Public Roads – Centerlines	2009	Lebanon Planning Dept.
Public Roads – Traffic Volumes	2014	Lebanon Planning Dept.
Railroads	1993	UNH CSRC
Riverbank Protection District	2015	Lebanon Planning Dept.
Significant Ecological Areas*	2010	Ecosystem Management Consultants
Soil units, especially hydric	2005	NRCS (also available through Web Soil Survey)
Tagged Vector Contours (TVC)	1998	20-foot contour intervals (USGS)
Unfragmented Lands*	2010,13	EMC, Lebanon Planning Dept.
USGS Color infra-red photography	2010	Published: Jan 2011, 1-foot pixel
Vernal Pools*	2009,13	Ecosystem Management Consultants
Watershed boundaries	2002	UNH CSRC
Wildlife Crossing Areas*	2009,13	Ecosystem Management Consultants

\* Derivatives from 2008-2010 Natural Resources Inventory (NRI)

In addition to the three crossing areas that had been field checked in 2014-2015, 14 crossing areas were identified that had one or more of the following attributes:

- They were identified as a wildlife crossing area in the 2008-2010 NRI
- They had a high spatial or temporal species crossing frequency as determined in the field during the wildlife assessment portion of the NRI
- They abutted at least one unfragmented area of at least 500 acres
- They included 'pinch points' along roadways subject to potential development

Each of the 14 additional wildlife crossing areas were field checked between March 2015 and March 2016. Field site surveys included roadside transects on both sides of the crossing area that determined and recorded observations of all mammals and game birds that had approached and/or crossed the roadway. Observational sign was recorded by location and type

<sup>1</sup> API = Aerial Photo Interpretation

<sup>2</sup> NAIP = National Agriculture Imagery Program

using a hand-held Garmin 12XL GPS unit and a Canon Powershot 20XIS digital camera. These data were transferred to an ArcGIS 10.x platform and depicted on maps as attached.

## II. General Description of Lebanon's Wildlife Crossing Areas

### A. Landscape Context

The 2010 NRI Report, *Natural Lebanon* (Van de Poll 2010), described the landscape of Lebanon as follows:

*At 41.2 square miles, Lebanon is about average in size for the state of New Hampshire. Located along the western edge of the central part of the state, it shares a border with Hanover to the north, Enfield to the east, Plainfield to the south, and the state of Vermont to the west. Its shape is roughly square with its western edge following the sinuous course of the Connecticut River. The latter provides the lowest elevation in the City at 330 feet above sea level, a change of greater than 1300 feet from its highest elevation of 1656 feet on Eastman Hill. In general, the topography of Lebanon is fairly steep as it trends from highland ridges on its north, east and southern sides downwards into the central valley of the Mascoma River.*

Upland areas away from the Mascoma River and its major tributaries represent about three-quarters of the landscape, including several large unfragmented tracts of land that vary in size from over 470 acres to over 3000 acres.<sup>3</sup> The following table summarizes those tracts of land in Lebanon that exceeded 470 acres in size:

Name	ACRES in Lebanon	Location
<b>Landmark Lands</b>	3076.95	E of West Leb, S of DHMC, W of Mt Support Rd
<b>Greater Bass Hill</b>	1897.40	Southeast Lebanon surrounding Bass Hill
<b>Hibbard Bk Headwtrs</b>	1607.37	South Lebanon south of Cross Road
<b>Greater Farnum Hill</b>	1390.64	SW Lebanon east of airport surrounding Farnum Hill
<b>Airport South</b>	1374.27	SW Lebanon south of quarry, airport, Poverty Lane
<b>Signal Hill</b>	1210.36	North central Lebanon both sides of Alden Rd
<b>Mt. Tug</b>	881.69	NE Lebanon W of Ruddsboro Road around Mt. Tug
<b>Storrs Hill North</b>	815.13	South central Lebanon north of Storrs Hill
<b>Eastman Hill West</b>	541.67	East Lebanon N of I-89 and W of Eastman Hill
<b>Mt. Support</b>	474.13	North central Lebanon between Rix Ledges & Mink Bk

With the exception of Airport South, each of these tracts were noted to have two or more major wildlife crossing areas along their edges. Four of the major crossing sites were found along the edges of the largest unfragmented block in Lebanon, the Landmark Lands. Three major crossing sites were identified for Greater Bass Hill, Hibbard Brook Headwaters, and Mt. Tug.<sup>4</sup> Two major

<sup>3</sup> It should be noted that three of the smaller unfragmented blocks listed in this table are actually much larger when lands outside of Lebanon are included, especially northeast of Mt. Tug, which exceeds 7500 acres when lands in Hanover, Canaan, and Enfield are included.

<sup>4</sup> A third major crossing area was identified for Mt. Support along Etna Road at the Lebanon-Hanover town line, however this site had already been reported to the Town of Hanover during a study of the Mink Brook Highlands Area in 2009 (see Hanover town files for this report).

crossing areas were identified and studied at Greater Farnum Hill, Mount Support, Signal Hill, Storrs Hill North and Eastman Hill West. Although several (i.e. 48) other wildlife crossing sites were identified during the 2008-2010 NRI, these were deemed to be too localized or insignificant to warrant a more in-depth study at this time.

The following table summarizes the top three attributes for each of these largest unfragmented blocks in Lebanon:

Name	Attrib_1	Attrib_2	Attrib_3
<b>Landmark Lands</b>	wildlife habitat	remote wetlands	deer wintering area
<b>Greater Bass Hill</b>	open fields	hardwood seeps	Into Enfield
<b>Hibbard Bk Headwtrs</b>	extensive wetlands	rich mesic soils	Into Plainfield
<b>Greater Farnum Hill</b>	wildlife habitat	upland ridgeline	open fields adjacent
<b>Airport South</b>	extensive wetlands	rich soils	wildlife habitat
<b>Signal Hill</b>	open fields	deer wintering area	riparian zones
<b>Mt. Tug</b>	upland mixed habitat	old growth oak	Into Hanover
<b>Storrs Hill North</b>	riparian habitat	open fields	semi-rich soils
<b>Eastman Hill West</b>	riparian habitat	vernal pools	Into Enfield
<b>Mt. Support</b>	wildlife habitat	seepage wetlands	Into Hanover

Several other attributes were noted for these unfragmented lands; these are included in the detailed descriptions of each crossing area below.

## B. Species Summary

White-tailed Deer – *Odocoileus virginianus* was found virtually throughout the city. Evidence of this species included direct sightings, tracks, scat, barking (e.g. of hemlock), twig browse, buck rubs, beds, hair, antler, bone, and aural clues such as snorts and bounding breaks. Because of their prevalence in the region, only areas of significant sign were noted on the attached maps. ‘Significance’ in this case included active bedding areas, wintering areas, well-used game trails, and major feeding areas. Although it was difficult to estimate their actual population based on such sign, it was evident that the deer population in Lebanon exceeded the statewide average of about 13 per square mile. Most deer sign indicated between two and four individuals per family group. This average number was typically exceeded in winter, when groups of between six and ten individuals were recorded. It is likely that in wintering yards significantly larger herds can be recorded, particularly in the Landmark Lands. This was not directly observed, however, since the winters of 2014-2015 and 2015-2016 lacked sufficient snow depths to induce consistent yarding behavior.



A total of 111 significant deer observation areas was noted during this study. These spanned all but the Mt. Tug crossing area, although it is probable that they inhabit this crossing site as well. Because of their numbers, white-tailed deer provided the most reliable indicator of a crossing area. For example, it was

noted that where game trails were observed, these were largely a result of repeated travel by white-tailed deer. A number of other species were typically associated with deer crossing sites, notably eastern coyote, the second most common species noted.

Eastern Coyote – *Canis latrans* var. was also widespread throughout the City of Lebanon and was found in virtually all locales. Sightings, tracks, scat, scent-marking sites, kill sites, fur, bone, and skulls were recorded as evidence of their presence. Because of their predatory nature, even the passing of a single individual was noted on the attached map of observation records. Most, however, involved two or three individuals moving along a game (i.e. deer) trail. A maximum of four individuals were noted at one locale in winter, although much larger pack sizes have been recorded by local residents.<sup>5</sup>



A total of 57 records were recorded from all but four crossing areas. Sites without coyote evidence during the 2015-2106 study time period included Signal Hill, Ruddsboro Gap, Eastman Hill West, and Slayton Hill Road – Adams. Coyote sign was recorded at all four of these areas, however, during the NRI time period of 2008-2010.

Anecdotal records were also reported for all of these areas except Ruddsboro Gap. Areas where coyotes appeared to be very frequent included the Landmark Lands, Mt. Support, and the Mascoma River near Route 4. At least two deer kill sites were found, one of which, was based on an apparent failed attempt by a deer to cross the highway fence along Route 120.

Red Fox – *Vulpes vulpes* was the third most common species recorded with a total of 23 records (11%). This small reddish canine was frequent wherever open fields and brushy borders were present. They were also common near scrub-shrub wetlands and wet meadows, for example, along Meriden Road. The highest concentration of fox sign was below Rix Ledges, along the powerlines at Boston Lot, and in the Mt. Support area. Sign included sightings, track, scat, beds, and scent marks. Most fox track was sighted along existing game trails. Near the actual road crossings some track evidence was more irregular. Single individuals were the norm, although occasionally two track sets were seen together, particularly in January. Given their preference for open ground and edge habitats, and their estimated home



Derek Marshall photo

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<sup>5</sup> Steve Wood, p.c. 2015.

range size of between 250 and 650 acres, the total population of red fox in Lebanon could range from 18 to 46 breeding pairs.

Raccoon – *Procyon lotor* was observed seven times during the 2015-2016 wildlife crossing survey and five times during the survey of 2013. Observations included sightings (including roadkill), scat, track, and den trees. Many more records were noted during the NRI that investigated general woodland habitats



of Lebanon. Raccoon was a common and frequent inhabitant of the forests and forest edges of the city, with an apparent preference for a mix of habitats near riparian areas. Raccoon tracks were readily seen during the NRI along all of the major rivers and streams, and therefore it was not surprising to record observations of them at all of the crossing areas that were in close proximity to perennial waterways, such as along Etna Road, near Route 120, along the Mascoma River and at Boston Lot. Their tolerance for fragmented habitats near human settlement has made them subject to roadkill. As a result, this species accounted for most of the medium to large mammals observed lying along roadways. Raccoon is also subject to population

outbreaks due to their high fecundity rate and avoidance of keystone predators within fragmented habitats, however, mammalian rabies tends to keep any overpopulation trend in check. Rabies outbreaks are infrequent but are steadily increasing in the Northeast. According to the CDC, bad outbreak years for raccoon in New Hampshire were 1995, 2008, and 2014.

Black Bear – *Ursus americanus* was found throughout the City of Lebanon, however crossing data was limited owing to their winter dormancy behavior. Observational sign included sightings, track, scat, excavations, bite marks, claw marks, feeding sites, and trails. Bear sign was recorded in 2013 and 2015-16 at 11 of the major wildlife crossing sites, although the latter study uncovered crossing areas at just four of these sites: Route 120, Rix Ledges - Etna Road, Ruddsboro Gap, and Mascoma River – Rt 4. This finding was not surprising considering the amount of bear sign that was documented at the Landmark Lands during the NRI as well as the illegal bear feeding station found along Route 120 in 2013. In general, black bear in Lebanon prefer remote woodlands with a good mix of upland and wetland habitats. Critical to their survival are hard mast feeding areas in fall (primarily beech and oak), dense woodlands with ample shelter for their winter dormancy (e.g. root mounds, hollow trees, small caves, dense spruce seedlings, etc.), and riparian floodplains or basin swamps that provide early green shoots in spring. Other habitat features that amplify population success include well-distributed rotten logs (for feeding on grubs and ants), white ash and beech stands (for feeding on spring buds), conifer stands that provide marking trees (especially red pine – including telephone poles!), large white pines or hemlocks for ‘baby-sitter trees,’ open ridgelines that provide good blueberry mast, and mature hemlock stands for the occasional meal of truffle. Based on field evidence of territorial marking by bear in Lebanon, it was apparent that there were several residential areas in unfragmented landscapes such as the Landmark Lands, Mt. Support – Rix Ledges, Mt. Tug, and



Farnum Hill. Given the estimated territory size of the species, there could be as many as 15 – 25 individuals in the city with four to six family groups at any given time.

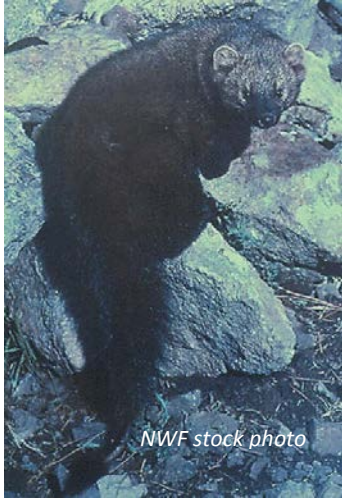
Bobcat – *Lynx rufus* was an infrequent predator in Lebanon as evidenced by a general lack of records. The 2008-2010 NRI documented scattered bobcat sign in all areas of the city by virtue of track, scat, claw marks, kill sites, and dens. The 2010 wildlife survey recorded just one individual at Meriden Road near Great Brook Road. This happened to be the exact spot for one of five records in 2015-16. The other four records were all in the Rix Ledges-Etna Road area, and included two den sites. It is probable that these denning areas were occupied by the same family group given their proximity to one another. No crossing



data was recorded for 2013 for this species. Bobcat represents one of the keystone or apex predator species in the region with some of the most exacting habitat requirements. Den sites are generally found in talus boulder areas with good shelter and ample late winter sun. During the NRI survey, only 12 areas meeting this description were found in the city. Four were found on or near Rix Ledges, four in the Landmark lands, and one each on Mt. Tug, at True's Brook, on the Cole Woodlands property, and near the Airport ledges.<sup>6</sup> Between 2008 and 2016, evidence of active denning was found at just four of these sites. Other habitat requirements include areas where a sufficient prey base exists, which include a wide variety of cover types such as dense hardwood sapling groves (snowshoe hare); dense spruce-fir seedling areas (snowshoe hare); open fields and their edges (snowshoe hare, woodchuck, mice, moles, deer fawns); open marshes and their edges (meadow vole, snowshoe hare, muskrat, beaver, deer fawns); dense conifer stands / deer wintering areas (deer); and riparian habitats (deer fawns, moles, mice, gray squirrel, snowshoe hare). Given their very wide-ranging nature (i.e. 5 – 25 square miles) and their normally heightened sensitivity to human settlement, it is probable that fewer than eight individuals reside in Lebanon at any one time.

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<sup>6</sup> Given the lack of complete coverage of all field areas during the NRI, it is probable that a number of potential denning sites for bobcat exist that were not detected. The mean size of the 12 sites were observed was just .11 acres. One of the four active denning sites was even smaller than this.



Fisher – *Martes pennanti* was observed in crossing areas as many times as bobcat. It was also recorded during the NRI in a wide variety of locales across the city. A typical inhabitant of deep woods away from civilization, the fisher is fond of conifer stands that favor its primary arboreal prey, red squirrel. It also frequents old growth woodlands with both hardwoods and softwoods to optimize cavity den sites and search out other potential cavity dwellers to eat (e.g. flying squirrel, gray squirrel, bird eggs, mice, voles, etc.). Fisher track was observed at five of the major crossing locales, which included a few that were in fairly close proximity to development: Daisy Hill Road, Slayton Hill – Adams, Mascoma – Route 4, Route 120, and Boston Lot – Route 10. In terms of road crossings, fisher was one of the few wide-ranging animals recorded to have utilized culverts to pass under roadways. This occurred at Route 120 and Route 10. A denizen of deep woods with ample forest cover, the home range size for fisher typically varies between 1.0 and 15 square miles, with the

larger ranges ascribed to dispersing males. Give their very solitary and aggressive nature – males will actually predate females they have just bred with (and vice versa), territories rarely overlap. An estimate for the number of fisher in Lebanon ranges from 5 to 35 individuals.

Porcupine – *Erethizon dorsatum* was an infrequent visitor to the major wildlife crossing areas and was instead more commonly found moving between localized patches of woodlands. Their ability to ward off predators and optimize a variety of forested habitats make them less reliant on certain road crossing



areas than the more wide-ranging species. A porcupine's poor sense of sight and slow-moving habits make it very prone to being killed by moving cars, however, and road-killed animals were observed to be equally as frequent as raccoon. A single carcass was also seen well away from the road near Rix Ledges, where it was suspected that either a fisher or bobcat caused its demise. Based on the well-cleaned pelt, fisher predation was likely. Porcupines are generally solitary animals outside of the late spring breeding season, and their home ranges are fairly small. The typical home range for a female is less than 65 acres, whereas a male home range may vary from 100 to 165 acres.

Since winter activity is greatly reduced, the likelihood of them crossing a roadway at that time is slim. High use areas in any given woodland include talus slopes, where both denning and sapling feeding opportunities are maximized, as well as large-bole conifer stands where both tree shelter and twig browse is more readily available. In general, porcupine presence was detected during the field surveys by sightings, track, scat, browse, carcasses, and dens. During the 2015-2016 survey, the three crossing areas were determined by repeated trails from one side of the road to the other. These were present at Route 120 and two locations at Rix Ledges – Etna Road. The proximity of the two talus slopes in these

areas likely favored their willingness to risk road mortality in order to move between feeding sites and denning areas.

Other Species – the above eight species were the principal mammals associated with wildlife crossing areas in Lebanon. During the 2015-16 survey another three species were recorded: beaver (*Castor canadensis*), river otter (*Lutra canadensis*), and muskrat (*Ondatra zibethicus*). All three of these species were also recorded in 2013, along with striped skunk (*Mephitis mephitis*), ermine (*Mustela erminea*), and woodchuck (*Marmota monax*). The 2008-2010 NRI also included records of mink (*Neovison vison*), long-tailed weasel (*Mustela frenata*), gray fox (*Urocyon cinereoargenteus*), star-nosed mole (*Chondylura*



*cristata*), snowshoe hare (*Lepus americanus*), gray squirrel (*Sciurus carolinensis*), red squirrel (*Tamiasciurus hudsonicus*), and wild turkey (*Meleagris gallopavo*). Of these 13 other species, four are strict riparian associates that generally utilize riverine corridors for movement: otter, mink, beaver, and muskrat. All four species were observed to utilize culverts or bridge underpasses for traveling beneath roadways in Lebanon. This occurred along Etna Road, Great Brook, Trues Brook, and the I-89 Exit 20 bridge. Two other species were observed to use this method of reducing

the risk of road mortality: striped skunk and ermine. These observations took place at Route 120, Cross Road, and the I-89 bridge near Exit 20. In all, eight species were found to have used culverts or bridges as movement corridors across roadways in Lebanon. Had all of the bridges been inspected in the city, it is probable that many more of the larger mammals also used this tactic to avoid crossing open roads.

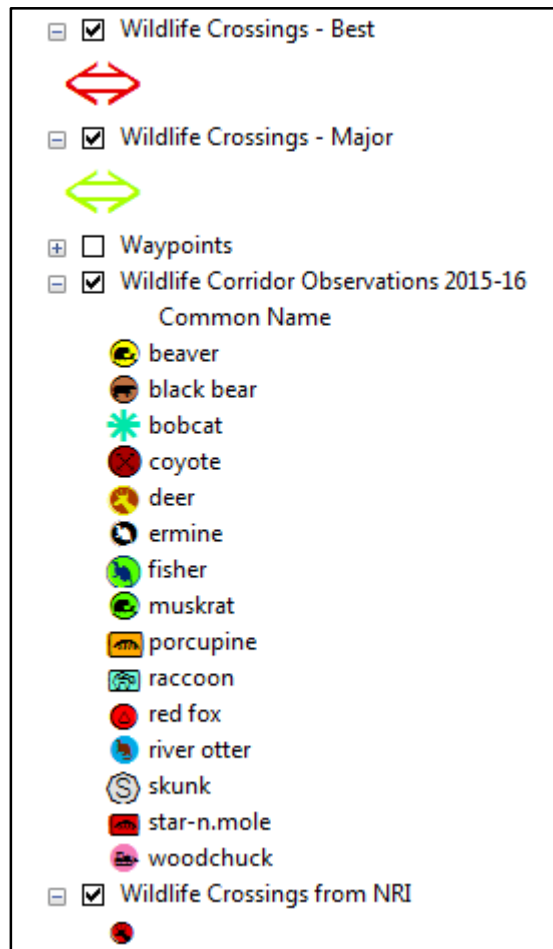
The other 13 species were found at six of the 17 wildlife crossing locations in the city. The most heavily used crossing area by these species was the Route 120 corridor, followed by the Rix Ledges – Etna Road corridor, and the I-89 Exit 19 corridor along the Mascoma River. Wild turkey



was found throughout the city, however, three crossing areas were actively being used: Mascoma River – Route 4, Signal Hill, and Hardy Hill. It appears that this species, being the only upland game bird that tends to leave a track record of their passing across roadways, was apt to be found along any of the rural roads that contained ample open ground habitat and brushy borders that served as feeding areas for this increasingly common species.

### III. Detailed Description of Each Crossing Area

The following descriptions of the wildlife crossing areas are intended to provide a summary of each of the 17 sites surveyed during the 2013 and 2015-2016 time periods. Each description contains the agreed-upon name of the crossing area, the general direction of travel found for the crossing animals, the width and type of crossing, the traffic volume of the roadway,<sup>7</sup> the primary species using the crossing site, and the unfragmented landscapes they are moving between. In addition, bulleted recommendations for improving each crossing area are provided. A map of each crossing area is shown below the textual data, each of which is set at a 1:10,000 scale. The following legend illustrates the wildlife species codes for those observations during the study time period. Note that major crossing sites are noted with green areas and the 'best' crossing sites are denoted with red arrows:



Note: wetland areas are outlined in yellow

<sup>7</sup> Given in Annual Average Daily Trips (AADT), and Traffic Volume (TV) level (1 – 6)

### A. Route 120

**Location:** Along Rt 120 on way to Hanover south of DHMC **Lat/Long of Centrum:** 43.668878/-72.253494

**Direction of Travel:** SW – NE      **Width of Roadway Opening:** 135 ft      **Width of Corridor:** 1150 ft

**Legis. Class of Road:** II      **Surface Type:** paved      **Surface Width:** 48 ft

**2014 AADT:** 22000      **TV level:** 6      **Maintenance:** state

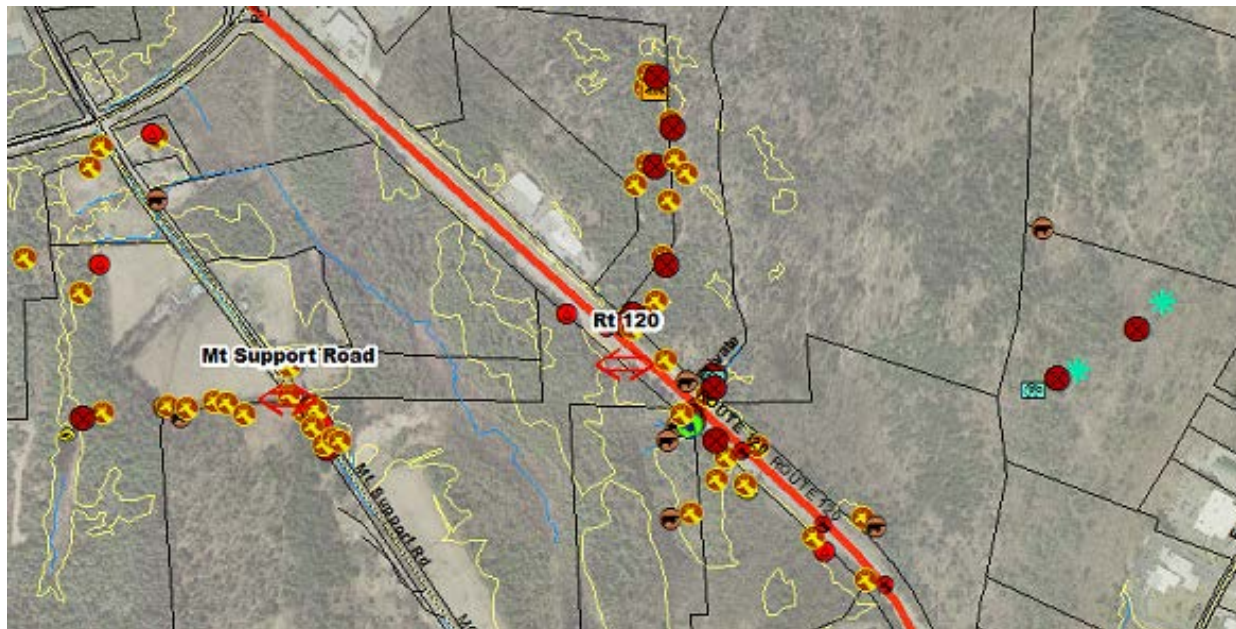
**Major Wildlife Species Found:** deer, coyote, bear, red fox, gray fox, fisher, raccoon, ermine

**Unfragmented Blocks:**      **South / West:** Mt. Support Rd East (123 ac.)  
   **North / East:** Mt. Support/Rix Ledge (474 ac. in Leb., 576 ac. in Hanover)

**General Description:** This was one of the most heavily used wildlife crossing areas in Lebanon. For that reason it had the most roadkill associated with it. It was also the most heavily studied, with at least four studies completed in association with the adjacent commercial & PBP development. Mostly unmanaged woodlands attend both sides and at least two culverts provide limited passage south of the Westin Element Hotel. A large wetland system on the west side offers wildlife shelter and refugia. This corridor connects to the Mt. Support crossing and provides the best passage from the Landmark Lands to Mt. Support/Rix Ledges.

#### Recommended Improvements:

- Improve wildlife crossing signage
- Decrease traffic speeds, set speed limits
- Replace all existing culverts with box or archway culverts (min. 4 ft high, 4 ft wide)
- Prevent artificial feeding stations or other attractants for crossing
- Eliminate highway fence on east side, or provide multiple breaks



## B. Mount Support

**Location:** Along Mt. Support Rd N of Timberwood Devel. **Lat/Long of Centrum:** 43.668324/ -72.260448

**Direction of Travel:** W – E

**Width of Roadway Opening:** 45 ft

**Width of Corridor:** 375 ft

**Legis. Class of Road:** V

**Surface Type:** paved **Surface Width:** 22 ft (plus bike path of 9 ft)

**2014 AADT:** 4602

**TV level:** 4

**Maintenance:** local

**Major Wildlife Species Found:** deer, coyote, red fox (bear during NRI)

**Unfragmented Blocks:**

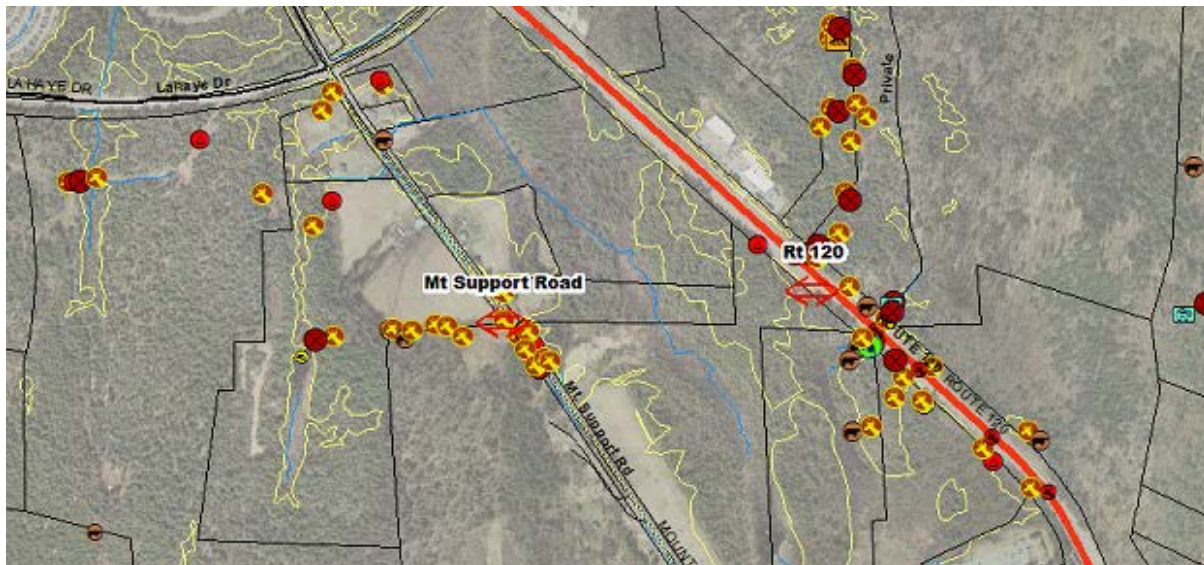
**South / West:** Landmark Lands (3077 ac. plus 195 ac. in Hanover)

**North / East:** Mt. Support Rd East (123 ac.)

**General Description:** This was one of three study sites in 2013, but was resurveyed in 2015 to determine the efficacy of the crossing “improvements” that had taken place as a result of the 2013 study. Large rock rip-rap was still found on the banks of the Dartmouth College land, and the iron fence was still present along the north sideline of the Timberwood Development. Game trails were becoming more concentrated because of these features, and the installation of the sidewalk/bike path was a further limiting feature. This crossing connects to the Route 120 crossing and provides the best passage opportunity between the Landmark Lands and the unfragmented forest blocks to the east and north.

### Recommended Improvements:

- Remove the large rip-rap for at least 50 feet adjacent to the Dartmouth College field
- Permanently protect the parcel 24-10 & secure development rights for parcels 24-2 and 24-3 on the west side of Mt. Support Rd and parcel 24-8 to the east next to Rt 120
- Secure a protective easement for the north 300 feet of the West parcel
- Improve the single intermittent stream culvert next to Timberwood by replacing with a 4-foot box culvert and removing 50 more feet of iron fence on the east side of Mt. Support Rd



### C. I-89 / Exit 19 (including Miracle Mile)

**Location:** I-89 at Exit 19 at base of Poverty Lane

**Lat/Long of Centrum:** 43.636389/ -72.284933

**Direction of Travel:** N – S

**Width of Roadway Opening:** 550-830 ft

**Width of Corridor:** 1000 ft

**Legis. Class of Road:** I, IV

**Surface Type:** paved

**Surface Width:** 38 ft (each lane) + 38 ft (Miracle Mi.)

**2014 AADT:** 34K, 33K, 16K

**TV level:** 6

**Maintenance:** state, local (Miracle Mile)

**Major Wildlife Species Found:** deer, coyote, red fox (plus several underneath Mascoma River bridge)

**Unfragmented Blocks:**

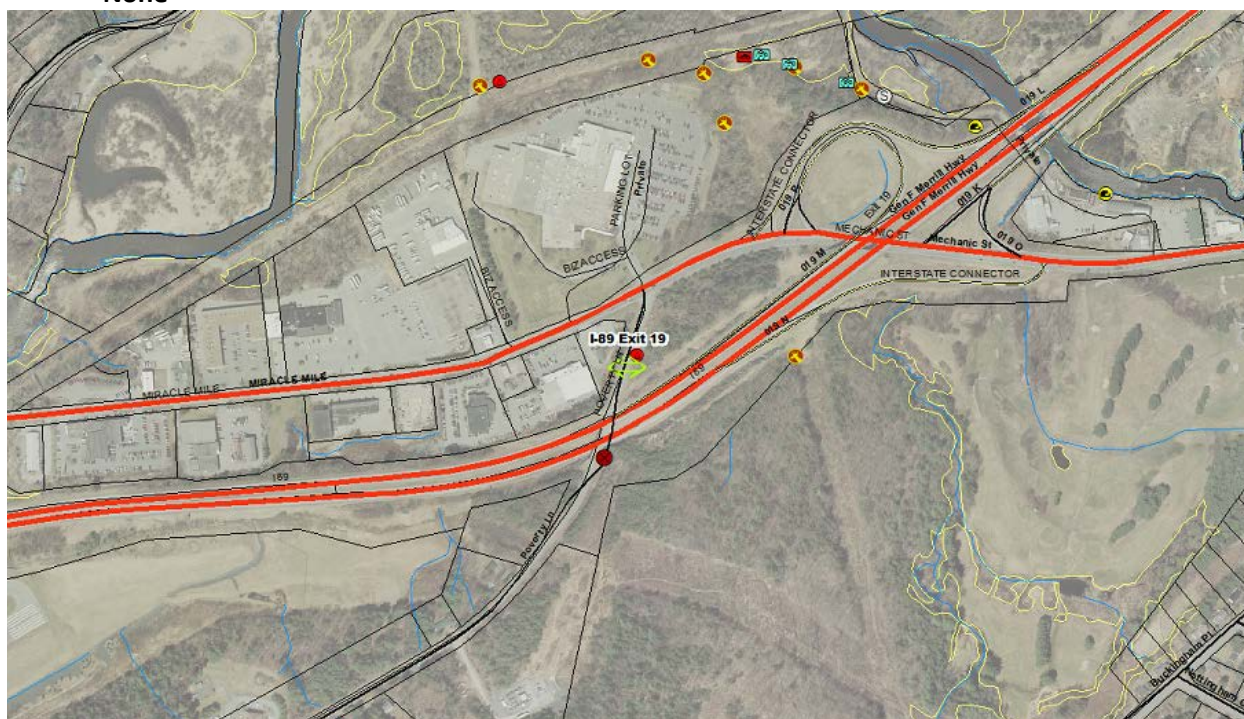
**South / West:** Greater Farnum Hill (1366 ac.)

**North / East:** Landmark Lands (3077 ac. in Leb., 195 ac. in Hanover)

**General Description:** This crossing was also studied in 2013, whereupon it was determined to be functionally inoperative. The combination of two, double lanes of Interstate I-89 and two lanes of the Miracle Mile has provided a barrier that very few animals can cross. The interstate includes a 30 – 40 foot high roadcut on the south side, four guardrails, and an AADT that equals or exceeds 67,000 vehicles a day in both directions. Both the red fox and coyote records were found to be crossing the highway bridge at lower Poverty Lane. Both observations recorded the use of a temporary refugium in the forested strip between the interstate and Miracle Mile before crossing the final lanes of traffic on Miracle Mile. The single deer record was from the base of the powerline on the west side of Exit 19. It appeared to have crossed all four lanes of interstate traffic and utilize the forested strip before continuing along the powerline towards the Mascoma River.

**Recommended Improvements:**

- None



#### D. Indian Ridge

**Location:** Along Indian Ridge North east of Sachem Village **Lat/Long of Centrum:** 43.684025/ -72.280224

**Direction of Travel:** S – N      **Width of Roadway Opening:** N/A      **Width of Corridor:** 2250 ft

**Legis. Class of Road:** N/A      **Surface Type:** N/A      **Surface Width:** N/A

**2014 AADT:** N/A      **TV level:** N/A      **Maintenance:** N/A

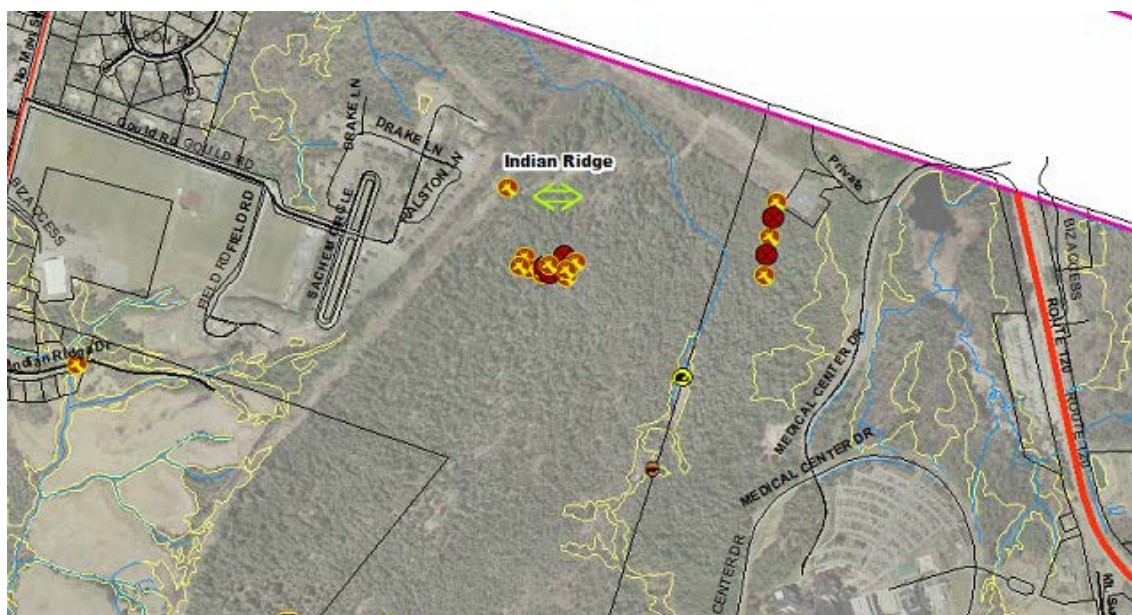
**Major Wildlife Species Found:** deer, coyote, bear, beaver

**Unfragmented Blocks:**      **South / West:** Landmark Lands (3077 ac. plus 195 ac. in Hanover)  
   **North / East:** Lower Mink Brook (Hanover) (210 ac. N of National Grid)

**General Description:** This site was selected to determine the movement of medium to large wildlife into and out of Lebanon along Indian Ridge. It was established to determine the potential effects of a cross road that could connect Sachem Village to the Dartmouth-Hitchcock Memorial Hospital land. It was the only site that did not involve a road crossing but rather included a portion of the very large unfragmented tract, the Landmark Lands. Currently, the principal fragmenting feature is the National Grid utility right-of-way that currently interrupts the unbroken forest with 200-foot wide strip of maintained scrubland. Several trails and old roadways crisscross the ridge, many of which support game trails that are primarily comprised of deer and coyote traffic. Towards the easterly edge lies a riparian wetland system that has served as a corridor for riparian wildlife such as beaver and mink. The upland forest buffer to this system provides exceptional habitat for movement along this waterway.

#### Recommended Improvements:

- Secure protective easements adjacent to the existing easements that would prevent the isolation of wildlife along the Lebanon-Hanover town line
- Maintain the current usage of this area as low-impact and non-motorized



### E. Boston Lot / Route 10

**Location:** Western Boston Lot to Wilder Dam area (Rt 10) **Lat/Long of Centrum:** 43.666155/ -72.299858

**Direction of Travel:** E – W      **Width of Roadway Opening:** 55 ft      **Width of Corridor:** 200 ft

**Legis. Class of Road:** II      **Surface Type:** paved      **Surface Width:** 32 ft

**2014 AADT:** 7752      **TV level:** 5      **Maintenance:** state

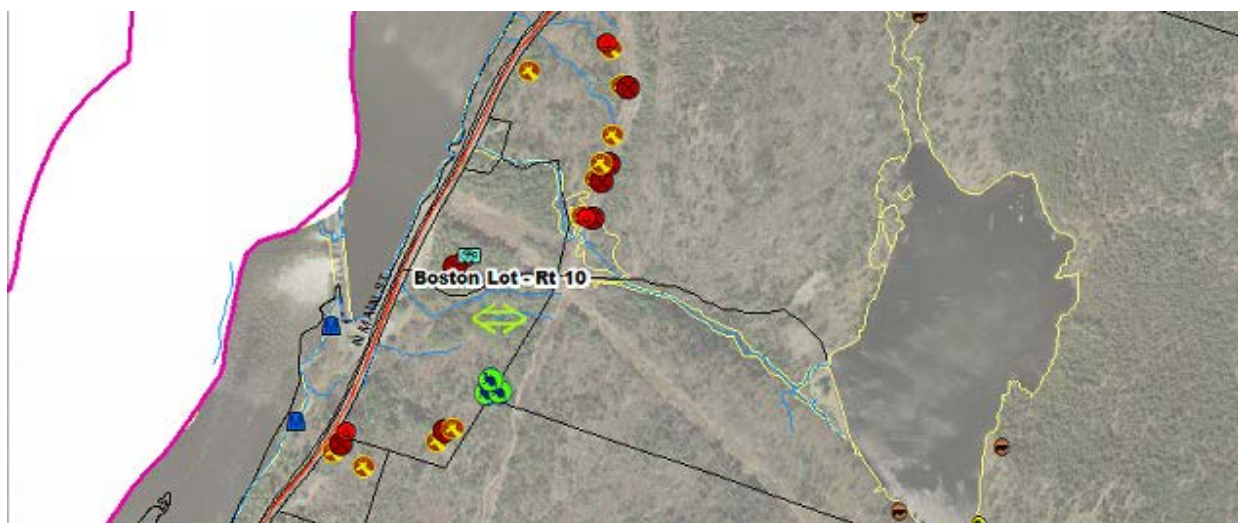
**Major Wildlife Species Found:** deer, coyote, red fox, fisher, raccoon

**Unfragmented Blocks:**      **South / West:** Connecticut River Corridor (350 ac. to West Leb bridge)  
   **North / East:** Landmark Lands (3077 ac. In Leb., 195 ac. in Hanover)

**General Description:** This crossing area completes the only other previously unstudied directional corridor leaving the Landmark Lands – to the west. Very little opportunity exists for medium to large wildlife to move onto or off of the Landmark Lands in this direction since roadways and development border the entire western side. In the vicinity of Wilder Dam there is a fairly undeveloped stretch that has been noted as the site of a crossing locale.<sup>8</sup> The field survey entailed the Connecticut River shoreline, the Route 10 roadside, and the major trails and powerline ROW's on Boston Lot. Deer and coyote were the principal species noted, although red fox and fisher were locally common. Based on field evidence near the edge of the TransCanada property across from Wilder Dam, it appeared that the crossing locale was fairly narrow towards the Connecticut River itself. Part of this crossing entailed a private property that was not able to be surveyed.

#### Recommended Improvements:

- Increase wildlife crossing signage, especially at the end of the old byway at the southwest corner of the TransCanada property
- Maintain road down to canoe portage since it serves a usable 'ramp' down to the river



<sup>8</sup> Moose, deer, fox, and raccoon roadkill has been reported for this area (Lebanon Police Dept., p.c.).

## F. Rix Ledges / Etna Road

**Location:** Etna Road below/E of Rix Ledges

**Lat/Long of Centrum:** 43.669181/ -72.237722

**Direction of Travel:** E – W

**Width of Roadway Opening:** 45 ft

**Width of Corridor:** 425 ft

**Legis. Class of Road:** II

**Surface Type:** paved

**Surface Width:** 50 ft

**2014 AADT:** (not recorded)

**TV level:** 4

**Maintenance:** state

**Major Wildlife Species Found:** deer, coyote, red fox, bobcat, raccoon, mink, beaver

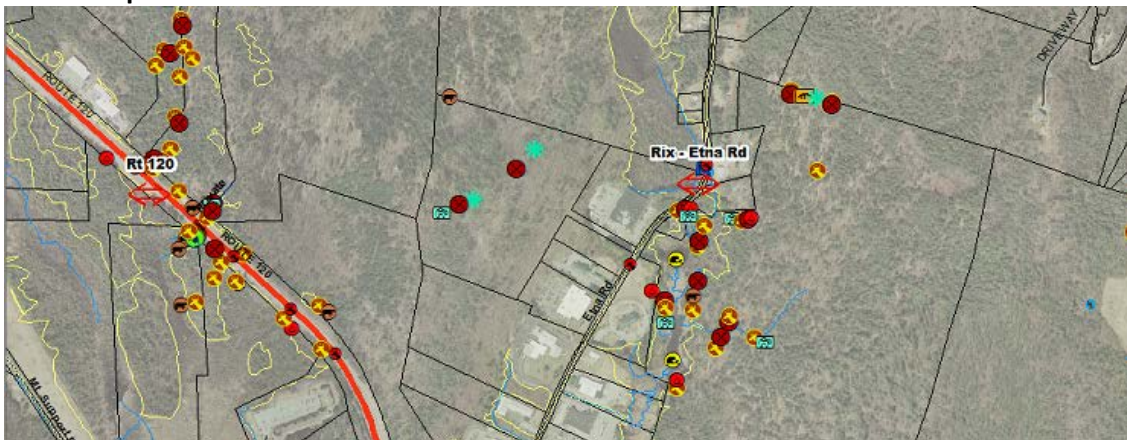
**Unfragmented Blocks:** **South / West:** Mt. Support (474 ac. In Leb., 576 ac. in Hanover)

**North / East:** Signal Hill (1210 ac. In Leb., 260 ac. in Hanover)

**General Description:** This was the second-most active wildlife corridor area in Lebanon. Given the remarkable wildlife habitat to the east and west of the crossing this was not surprising. The crossing locale had a fairly narrow width between UniFirst on the west and the NHDOT garage on the east. A small residence belonging to James Campion pinches the upland corridor on the east side as well, and a large dead-standing forested swamp blocks upland passage across from the DOT garage. The forest edges are fairly close to the road on both sides of the road, and these provide good cover, but the fairly sharp curve at the stream crossing prevents good visibility of crossing wildlife. The stream crossing culvert itself is fairly small but has been observed to allow for passage by mink. A number of roadkill animals have been reported for this zone, including bear, deer, beaver, and raccoon. The most significant concern lies with the fact that active bobcat dens are found on either side of this crossing area.

### Recommended Improvements:

- Secure protective easements from James Campion for the northern strip of his land as a part of his proposed development of his land for a natural gas distribution facility
- Continue the good work of the Upper Valley Land Trust by securing an easement to the northern strip of UniFirst land that contains the principal wildlife crossing zone
- Post speed limit and wildlife crossing signage above and below the crossing area
- Increase the size of the underpass culvert at the perennial stream to allow for passage by other species



## G. Signal Hill

**Location:** Summit & East side Signal Hill at Stevens Rd

**Lat/Long of Centrum:** 43.66704/ -72.219951

**Direction of Travel:** E – W

**Width of Roadway Opening:** 35 ft

**Width of Corridor:** 375 ft

**Legis. Class of Road:** V

**Surface Type:** paved

**Surface Width:** 18 ft

**2014 AADT:** (not recorded)

**TV level:** 3

**Maintenance:** local

**Major Wildlife Species Found:** deer, coyote, red fox, otter

**Unfragmented Blocks:**

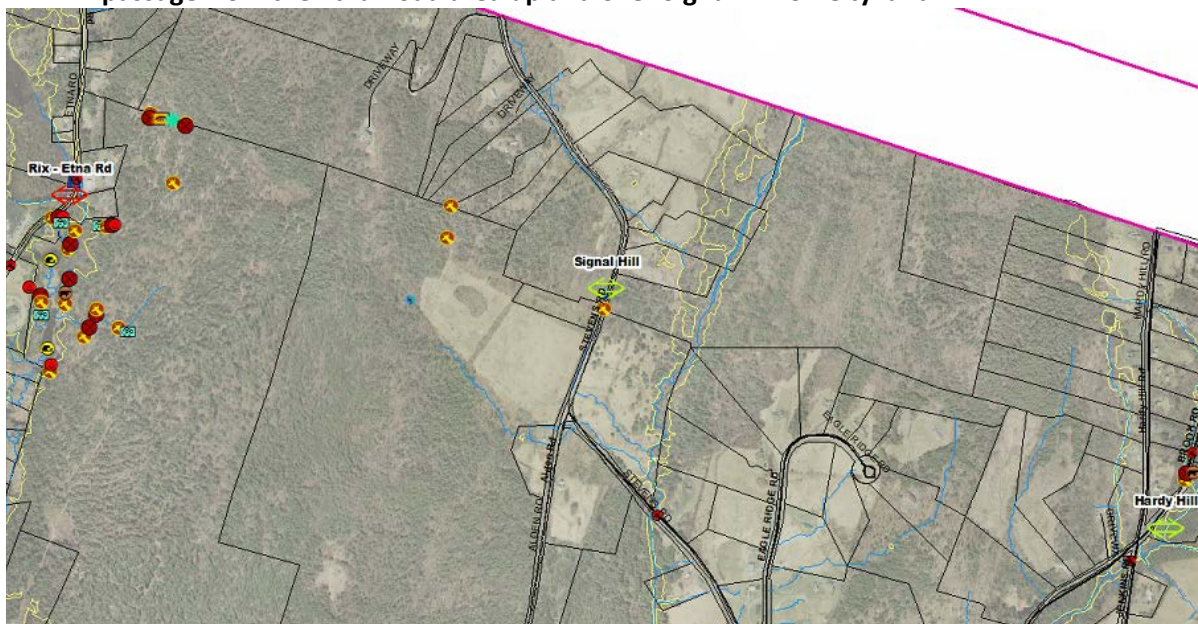
**South / West:** Signal Hill (1210 ac. In Leb., 260 ac. in Hanover)

**North / East:** Eagle Ridge (250 ac. in Leb., 450 ac. in Hanover)

**General Description:** With permission from the landowners, the Signal Ridge survey included lands from Etna Road all the way across Signal Hill summit to Stevens Road. In spite of this increase in survey area, most observations of the native wildlife were determined be fairly localized. Very little movement was noted across Stevens Road, and only a single, well-used deer trail was recorded. Scattered deer trails were also found all the way up the height of land at the Hanover town line, none of which were significant. It is likely that the rural landscape and diverse cover types allowed for widely dispersed movement from one side of the road to the other. The single otter track noted above appeared to originate in the waterway near Etna Road and proceed over Signal Hill ridge and downstream along a tributary of Hardy Brook.

### Recommended Improvements:

- Seek conservation agreements for the Moore, Rutter, and Crane properties on either side of Stevens Road to allow for uninterrupted passage at the highest use area
- Secure a conservation restriction on the north part of the Campion property to allow for passage from the Etna Road area up and over Signal Hill on City land



## H. Hardy Hill

**Location:** Hardy Hill & Brook Roads

**Lat/Long of Centrum:** 43.661374/ -72.201408

**Direction of Travel:** E – W

**Width of Roadway Opening:** 30 ft

**Width of Corridor:** 300 ft

**Legis. Class of Road:** V

**Surface Type:** paved

**Surface Width:** 35 ft

**2014 AADT:** (not recorded)

**TV level:** 3

**Maintenance:** local

**Major Wildlife Species Found:** deer, coyote, bear, otter (downstream)

**Unfragmented Blocks:**

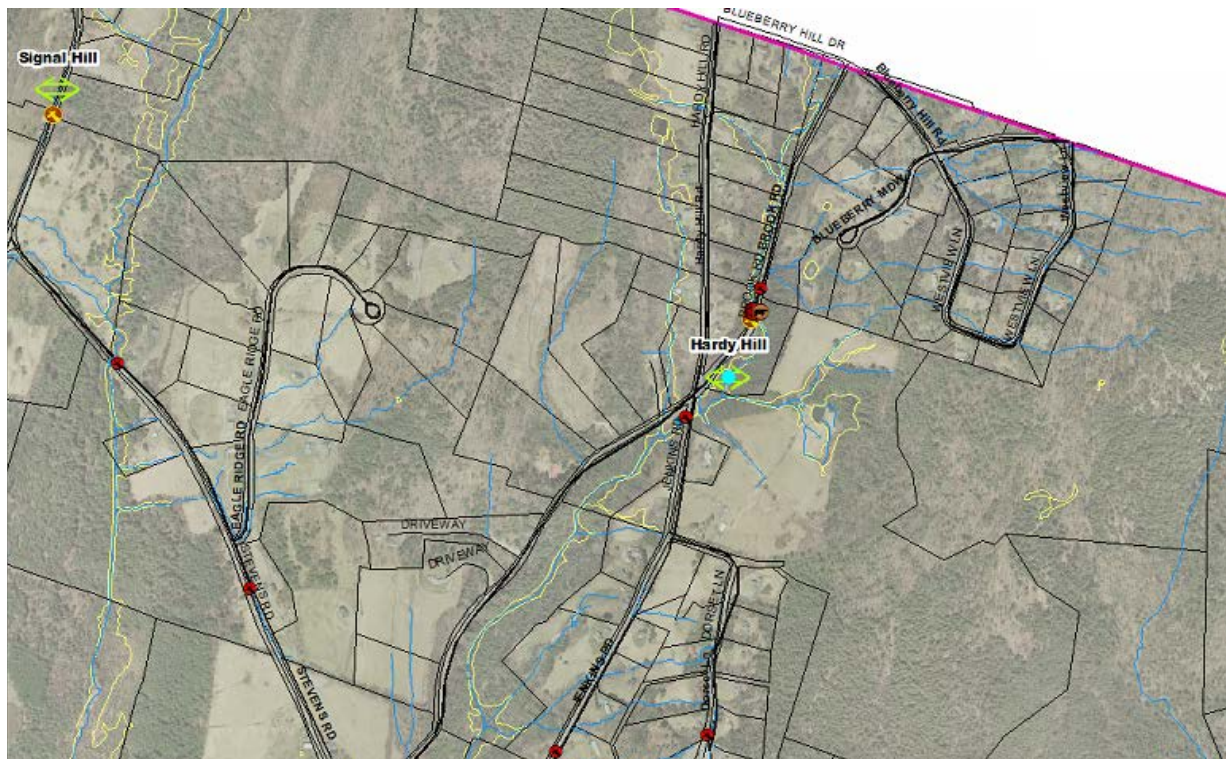
**South / West:** Eagle Ridge (312 ac. in Leb., 450 ac. in Hanover)

**North / East:** Mt. Tug (881 ac. in Leb., 575 ac. in Hanover)

**General Description:** The site was first identified during the NRI as one that had possible connection value between Signal Hill and Mt. Tug. The narrow 'triangle' between Hardy Hill Road and Brook Road did not appear to hold any restrictions to accessing either of these unfragmented blocks of land, and the subsequent field survey bore this out. Well-used game trails were found crossing Hardy Hill Road across unbroken agricultural land and adjacent forest stands. The riparian zone of Hardy Brook was an attractant to movement along and across Brook Road above the bridge near Hardy Hill Rd. Deer, coyote, and bear sign were frequent in this area, with evidence of long-term use (e.g. a bear trail). The proximity of these two large unfragmented tracts of excellent wildlife habitat made this a natural choice to study.

### Recommended Improvements:

- Post signage at brook crossing to indicate wildlife crossing area



## I. Ruddsboro Gap

**Location:** Town line at Ruddsboro Road

**Lat/Long of Centrum:** 43.660811/ -72.172098

**Direction of Travel:** SW - NE

**Width of Roadway Opening:** 30 ft

**Width of Corridor:** 585 ft

**Legis. Class of Road:** V

**Surface Type:** paved

**Surface Width:** 25 ft

**2014 AADT:** (not recorded)

**TV level:** 3

**Maintenance:** local

**Major Wildlife Species Found:** deer, coyote, bear, bobcat

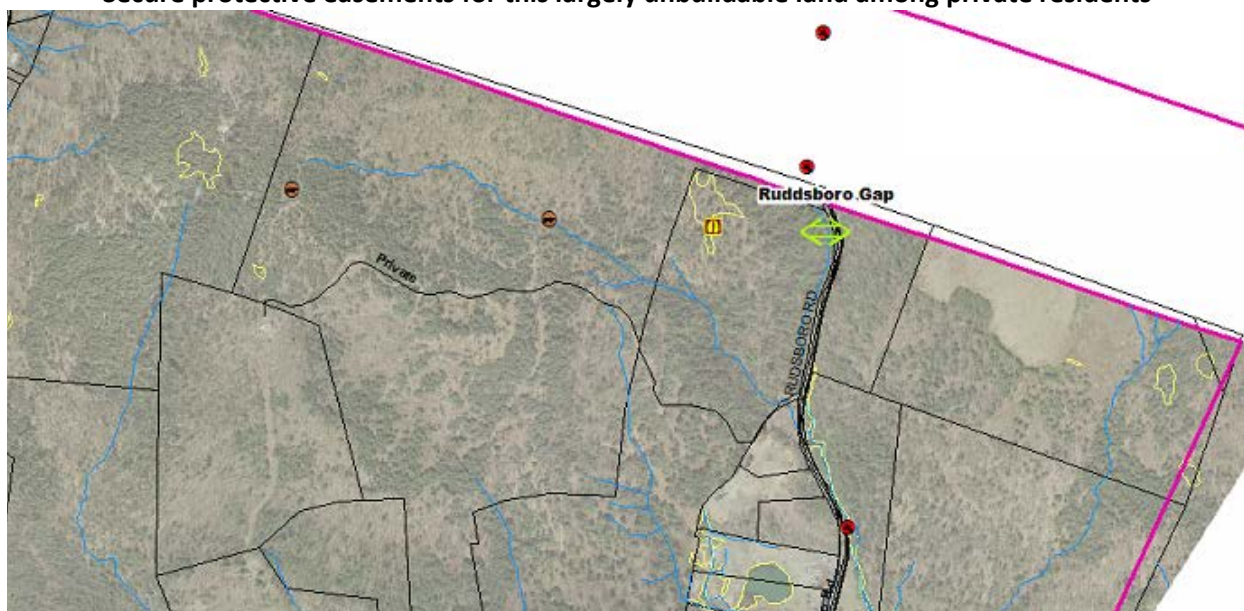
**Unfragmented Blocks:**           **South / West:** Mt. Tug (881 ac. in Leb., 575 ac. in Hanover)

**North / East:** Moose Mtn. South (167 ac. in Leb., 7000 ac. in Hanover, Enfield, & Canaan)

**General Description:** Ruddsboro Gap is technically in Hanover, yet ample wildlife crossing opportunities exist between the height-of-land and the town line. The greatest concentration of wildlife crossings appeared to be at the town line and just north of it along a stretch of about a tenth of a mile. Deer trails were frequent, which were utilized by coyote, and bear. During the NRI, a single bobcat trail was followed off of Mt. Tug in the vicinity of this crossing. Moose was also recorded as being frequent on Mt. Tug. This was not surprising given the fact that the lands north and east of Ruddsboro Road extend to Moose Mountain and beyond. The estimate of 7,000 acres excluded Class VI roads, which if considered as being free of barrier effects, would increase this roadless area to several tens of thousands of acres. This was clearly the largest unfragmented block of land that Lebanon is a part of.

### Recommended Improvements:

- Install wildlife crossing signs above and below the town line
- Encourage residents to remove residual barbed wire fencing that is no longer used for agriculture, especially around the spring on the west side of the road
- Secure protective easements for this largely unbuildable land among private residents



## J. Route 4 / Mascoma River

**Location:** Route 4 near Mill Rd next to the Mascoma River **Lat/Long of Centrum:** 43.641691/ -72.194552

**Direction of Travel:** NW - SE **Width of Roadway Opening:** N/A **Width of Corridor:** 950 ft

**Legis. Class of Road:** Class A trail **Surface Type:** dirt **Surface Width:** 14 ft (Mill Rd)

**2014 AADT:** 0 (Mill Rd.) **TV level:** 3 (Rt 4), 1 (Mill Rd) **Maintenance:** local

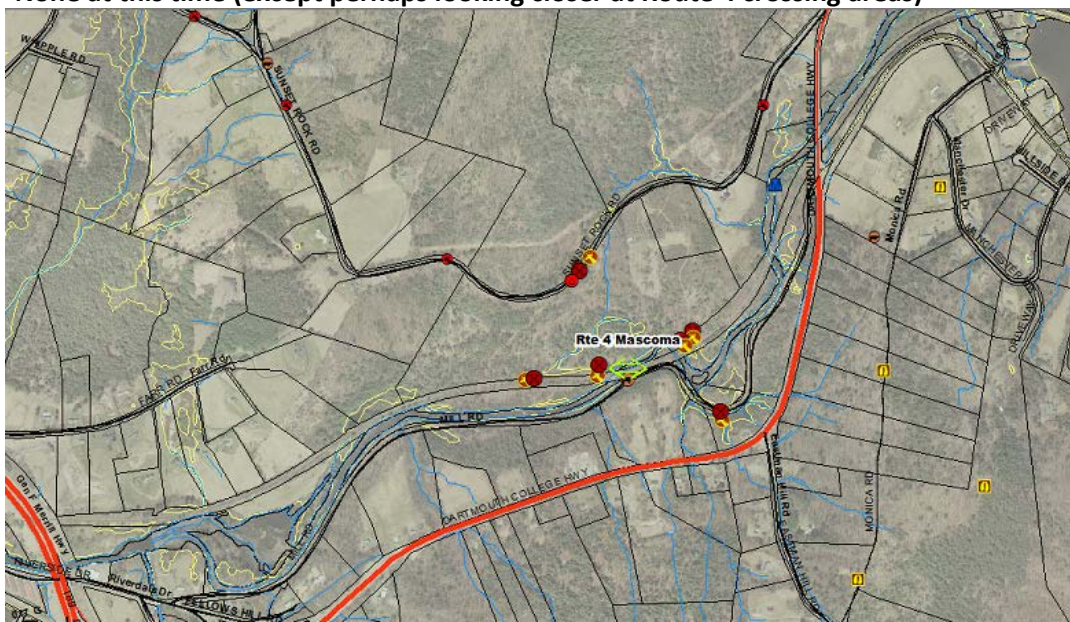
**Major Wildlife Species Found:** deer, coyote, red fox, bear

**Unfragmented Blocks:** **South / West:** NE Lebanon upper Mascoma River (175 ac.)  
**North / East:** Eastman Hill West (542 ac. In Lebanon, 70 ac. In Enfield)

**General Description:** The survey of this area was intended to determine if the Mascoma River was providing a significant barrier to wildlife passage between the Sunset Rock hillside to the north and Eastman Hill to the south. Field observations included game trails and sign along Mill Rd along the south side of the river and Sunset Rock Road on the north side of the river. Based on the well-used trails that descended kame terraces on both sides of the river, it was apparent that movement was fairly unrestricted. The species of concern were clearly upland migrants, since the riparian species were moving up and down the river corridor. Deer, coyote, red fox, and bear were observed to be moving across this rather wide corridor area. Some of the movement included crossing the railroad bridges that spanned the river. It was suspected that winter access across the river was more likely to be on snowy versus icy surfaces, especially for deer. It should be noted that no effort was made to determine where game trails crossed Route 4, especially since this road was under heavy construction during the survey time period (i.e. for the Route 4 bridge replacement).

### Recommended Improvements:

- None at this time (except perhaps looking closer at Route 4 crossing areas)



## K. Eastman Hill West

**Location:** Eastman Hill Road NW of Enfield town line

**Lat/Long of Centrum:** 43.628825/ -72.185477

**Direction of Travel:** W - E

**Width of Roadway Opening:** 35 ft

**Width of Corridor:** 500 ft

**Legis. Class of Road:** V

**Surface Type:** paved

**Surface Width:** 18 ft

**2014 AADT:** (not recorded)

**TV level:** 3

**Maintenance:** local

**Major Wildlife Species Found:** deer, coyote, red fox

**Unfragmented Blocks:**      **South / West:** Eastman Hill West (542 ac. In Lebanon, 70 ac. In Enfield)

**North / East:** Eastman Hill East (335 ac. in Leb., >7500 ac. in Enfield)

**General Description:** Not unlike the Hardy Hill area, Eastman Hill Road traverses a rural landscape that was far more permeable than much of the habitat areas of Lebanon. The four crossing sites that were identified during the NRI and the present study all entailed fairly lightly used deer trails with coyote sign. Red fox was also noted during previous studies of the area. The present crossing locale was confirmed as having multiple trails in a fairly short span that was being pressured by adjacent development. A significant gravel operation and roadfill dump eliminated one crossing area uphill of this site, and residential development downhill has likely pushed wildlife crossings into the current use area. Considering the size of the unfragmented block of land in Enfield, it is probable that the Eastman Hill Rd area will continue to serve as the edge of residential populations rather than a centrally utilized corridor.

### Recommended Improvements:

- Install signage to help elevate awareness of the current crossing areas
- Monitor wildlife activities across the road to determine usage by more sensitive species such as bear and bobcat



## L. Daisy Hill Rd

**Location:** Base of Daisy Hill Rd above Great Bk

**Lat/Long of Centrum:** 43.623678/ -72.23157

**Direction of Travel:** W - E

**Width of Roadway Opening:** 35 ft

**Width of Corridor:** 135 ft

**Legis. Class of Road:** V

**Surface Type:** paved

**Surface Width:** 26 ft

**2014 AADT:** (not recorded)

**TV level:** 3

**Maintenance:** local

**Major Wildlife Species Found:** deer, coyote

**Unfragmented Blocks:**

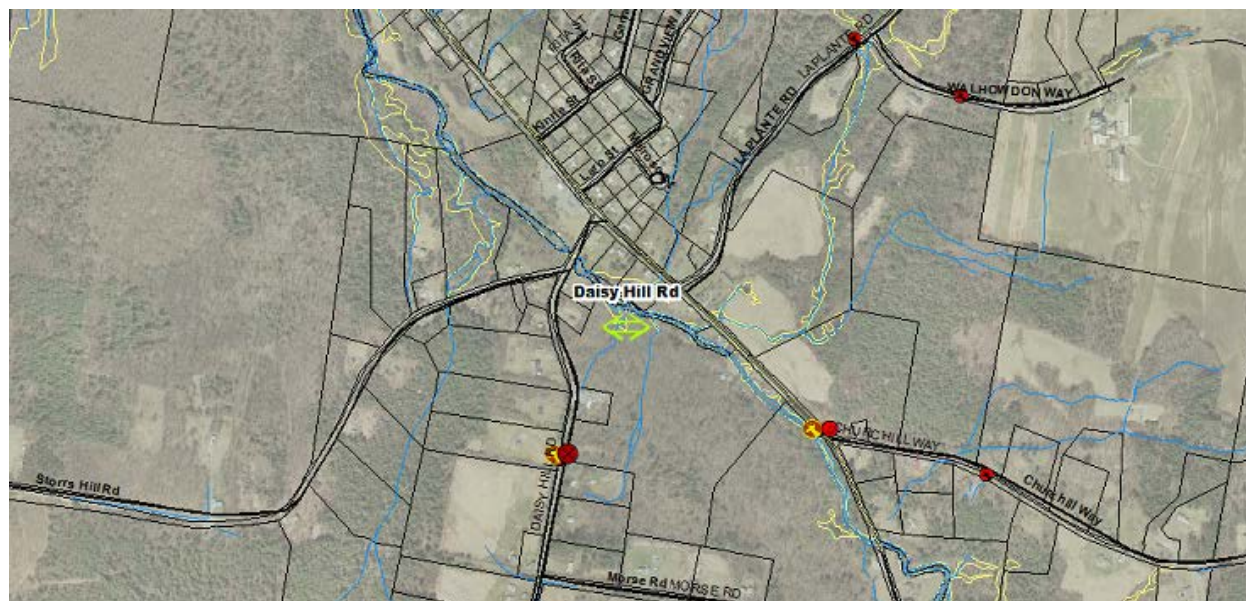
**South / West:** Storrs Hill South (331 ac.)

**North / East:** Daisy Hill East (391 ac.)

**General Description:** This relatively small crossing area presents a limited connection between two fairly small unfragmented blocks of land in central Lebanon. Of concern at this site is the possible connection between Storrs Hill and the much larger Greater Bass Hill unfragmented block on the east side of Great Brook. Because of current development patterns, the latter area could be significant for expanding the metapopulation diversity of those species in central Lebanon. The best crossing area on Daisy Hill Road was found about a quarter mile from Great Brook on a slight terrace. The very well-established deer and coyote trail was wedged between a driveway, a field edge hedgerow, and a new house on the west side of the road.

### Recommended Improvements:

- Advise the landowners of this crossing area and encourage the removal of unnecessary barbed wire fencing and gates that may prevent unimpeded passage by large wildlife species
- Monitor for use by other wide-ranging species, notably bobcat and bear



### M. Great Brook / Meriden Road

**Location:** Great Brook Road & Meriden Road

**Lat/Long of Centrum:** 43.601979/ -72.220228

**Direction of Travel:** W - E

**Width of Roadway Opening:** 50 ft

**Width of Corridor:** 280 ft

**Legis. Class of Road:** II

**Surface Type:** paved

**Surface Width:** 24 ft

**2014 AADT:** 2900

**TV level:** 3

**Maintenance:** state

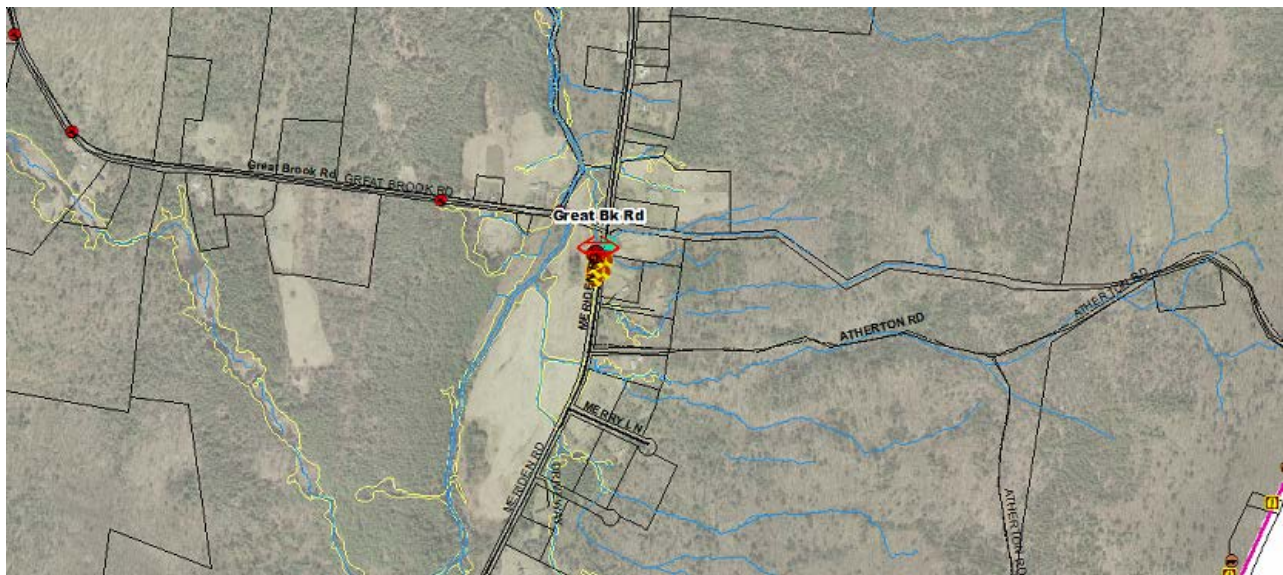
**Major Wildlife Species Found:** deer, coyote, bobcat

**Unfragmented Blocks:** **South / West:** Hibbard Brook Headwaters (1607 ac. In Leb., 2900 ac. In Plainfield)  
**North / East:** Greater Bass Hill (1697 ac. In Leb., 70 ac. In Enfield, 40. Ac. In Plainfield)

**General Description:** The junction of Meriden Road (Route 120) and Great Brook Road represents one of the most well-used crossing areas for wildlife between two of the largest unfragmented blocks of land in Lebanon. The landscape is generally rural, and therefore ample farmland and other open land exists for helping diversify wildlife habitat. A narrow hedgerow edge along Meriden Road provides little cover, however, and Great Brook adds to the east-west barrier by running north to south. Near Great Brook Road the brook widens into a scrub-shrub and forested floodplain, and provides greater cover for animals approaching Meriden Road. Several well-used deer and coyote trails were found in this vicinity, and during the last outing a bobcat track set was found following the northernmost trail. Other crossing area along Meriden Road exist, although this appeared to be consistently the most heavily used.

#### Recommended Improvements:

- Install wildlife crossing signage on both sides of Meriden Road
- Secure protective easements from the large-lot private landowners on either side of Meriden Road
- Maintain the farmland as currently configured to continue to offer good open land habitat



## N. Plainfield Town Line / Route 120 South

**Location:** Route 120 (Meriden Road) at Plainfield line

**Lat/Long of Centrum:** 43.589371/ -72.225719

**Direction of Travel:** W - E

**Width of Roadway Opening:** 50 ft

**Width of Corridor:** 725 ft

**Legis. Class of Road:** II

**Surface Type:** paved

**Surface Width:** 30 ft

**2014 AADT:** 2900

**TV level:** 3

**Maintenance:** state

**Major Wildlife Species Found:** deer, coyote, red fox, otter

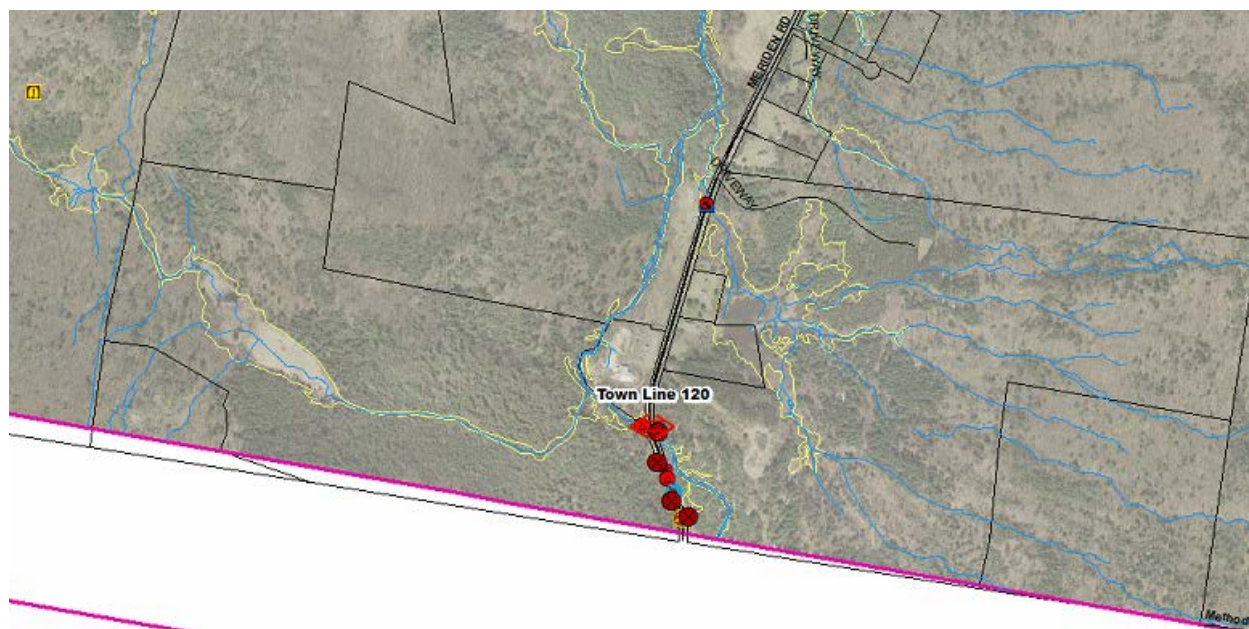
**Unfragmented Blocks: South / West:** Hibbard Brook Headwaters (1607 ac. In Leb., 2900 ac. In Plainfield)

**North / East:** Greater Bass Hill (1697 ac. In Leb., 70 ac. In Enfield, 40. Ac. In Plainfield)

**General Description:** This crossing area is fairly wide since it combines the edge of a saw mill yard, the crossing of Great Brook under the highway, and a ridge of conifer-dominated mixed woods that drops into the Great Brook ravine. Several crossing paths were observed, with deer, coyote, and red fox being the principal mammals noted. A single otter track was also recorded crossing the highway at a considerable distance from the bridge over Great Brook. The crossing area represents another critical link between two of the largest unfragmented forest blocks in Lebanon. Developed land and road crossings to the south in Plainfield suggest that this is the best long-term crossing site along the entirety of Meriden Road.

### Recommended Improvements:

- Add signage at either end of corridor area
- Seek protective easements from the Cole Family for the crossing area



#### O. Slayton Hill / Adams

**Location:** Poverty Lane at Ascutney View Farm (north)      **Lat/Long of Centrum:** 43.607717/ -72.259626

**Direction of Travel:** W - E      **Width of Roadway Opening:** 35 ft      **Width of Corridor:** 375 ft

**Legis. Class of Road:** V      **Surface Type:** paved      **Surface Width:** 16 ft

**2014 AADT:** 0      **TV level:** 3      **Maintenance:** local

**Major Wildlife Species Found:** deer

**Unfragmented Blocks:**      **South / West:** Greater Farnum Hill (1391 ac.)  
   **North / East:** Hibbard Brook Headwaters (1607 ac. In Leb., 2900 ac. In Plainfield)

**General Description:** The south sides of Slayton Hill on Slayton Hill Road and Poverty Lane are comprised of a mix of agricultural land and unbroken woodland. These two habitat types provide excellent habitat for wide-ranging mammals along a fairly low-density, rural residential zone on either side of Poverty Lane from Loomis Road to Cross Road moving west to east. Although several crossing areas were observed during the NRI, none were as active as the stretch of road just north of Ascutney View Farm where the forest and scrub cover approaches the road on both sides. Stonewall breaks in this vicinity add to the ease with which large animals can cross this little traveled road. Although only white-tailed deer were observed at this crossing area, it is most assuredly used by coyote, fox, bobcat, bear, and woodchuck.

#### **Recommended Improvements:**

- Continue land conservation conversations with the Townsend and Adams families to encourage them to provide permanent protections to this corridor area



## P. Poverty Lane / Farnum Hill

**Location:** Poverty Lane at Eversource ROW, Farnum Hill      **Lat/Long of Centrum:** 43.616403/ -72.288137

**Direction of Travel:** W - E      **Width of Roadway Opening:** 40 ft      **Width of Corridor:** 175 ft

**Legis. Class of Road:** V      **Surface Type:** paved      **Surface Width:** 20 ft

**2014 AADT:** 0      **TV level:** 3      **Maintenance:** local

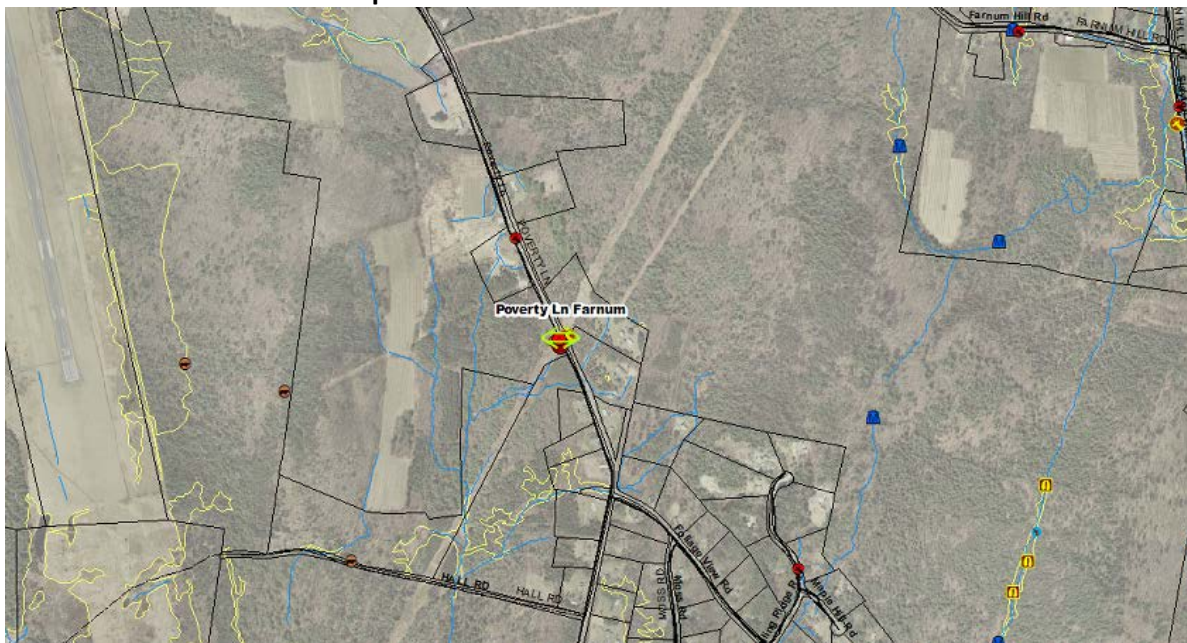
**Major Wildlife Species Found:** deer, coyote, red fox, bear

**Unfragmented Blocks:**      **South / West:** Airport South (1374 ac. In Leb., 450 ac. In Plainfield)  
   **North / East:** Greater Farnum Hill (1391 ac.)

**General Description:** The placement of the suspected wildlife corridor west of Farnum Hill was shifted northwards 500 feet based on field evidence. Both the NRI study and the recent survey found well-used game trails made by deer, coyote, fox, and bear crossing at or near the powerline ROW that crosses Poverty Lane in a SW-NE direction east of Poverty Lane Orchards. This area connects the large, unfragmented lands surrounding the municipal airport to the west and the Greater Farnum Hill unfragmented tract to the east. Although stretches of forest are also found at this crossing, the dense scrub-shrub zone within the ROW provides excellent shelter (and food) for crossing animals. Intermittent stream drainages that generally move in a southwesterly direction aid in the attraction of this corridor area.

### Recommended Improvements:

- Install wildlife crossing signage at this locale
- Engage in a conservation conversation with Steve Wood of Poverty Lane Orchards, and investigate the status of parcel 161-13 to the east to encourage a permanent conservation corridor between the airport and Farnum Hill



#### Q. Slayton Hill Rd / Ticknor

**Location:** Slayton Hill Rd at west edge Ticknor property      **Lat/Long of Centrum:** 43.627166/ -72.269792

**Direction of Travel:** W - E      **Width of Roadway Opening:** 40 ft      **Width of Corridor:** 400 ft

**Legis. Class of Road:** V      **Surface Type:** paved      **Surface Width:** 30 ft

**2014 AADT:** 0      **TV level:** 3      **Maintenance:** local

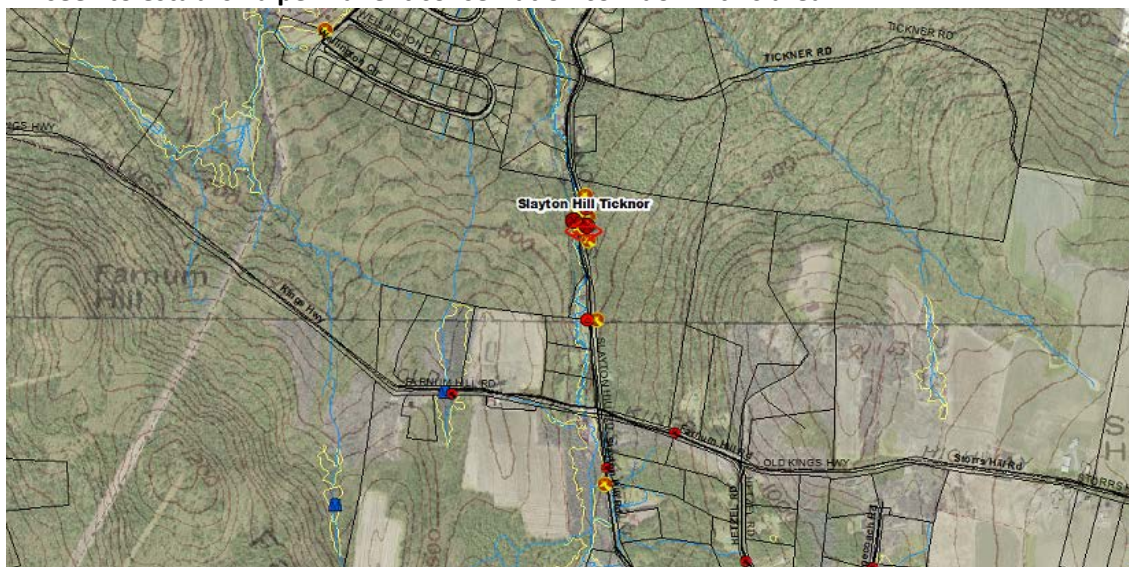
**Major Wildlife Species Found:** deer, coyote, red fox

**Unfragmented Blocks:**      **South / West:** Greater Farnum Hill (1391 ac.)  
   **North / East:** Storrs Hill North (815 ac.)

**General Description:** This crossing area was noted during the 2008-2010 NRI as a potentially critical connection between the Greater Farnum Hill area and the recently protected Storrs Hill property (Tomapo Farm). Additional crossing evidence was discovered in 2016 across a stretch of about 400 feet. This was in addition to a very well-used game trail about 500 feet further south. A second order stream that flows along the west side of Slayton Hill Road adds to the wildlife corridor value by providing a potential for riparian wildlife to move up and across Slayton Hill Road. This riparian system was ranked as very high value system by the NRI with a score of 1.49. The combination of upland and riparian forest provides an exceptional opportunity for wildlife crossing, hence it has been rated as one of the six best crossing areas in Lebanon.

#### Recommended Improvements:

- Provide adequate wildlife crossing signage beginning at Old Kings Highway in the south and ending at the northeast corner of the Carter Country Club property in the north
- Ensure adequate protections from the infrastructure associated with the proposed development of the Carter Country Club property
- Engage in conservation conversations with the two abutters to Ticknor Woods to the east and seek to establish a permanent conservation corridor in this area



#### IV. Summary

From March 2015 to March 2016 a field-based survey was completed of 14 wildlife crossing areas that had been identified during the 2008-2010 natural resources inventory (NRI) of Lebanon. This survey was completed as a follow-up to the 2013 field-based survey of three additional crossing areas at Mt. Support Road, Route 120 near the (now) Westin Element Hotel, and Interstate I-89 just west of Exit 19. The current study identified 218 concentrated use areas among 10 species using these 14 crossing locales. The most prevalent was white-tailed deer (N = 111), followed by eastern coyote (57), red fox (23), raccoon (7), black bear (5), and bobcat (4). All of the remaining four species were riparian associates, and were generally found crossing roadways alongside stream underpasses.

Wildlife crossing areas varied between 135 feet and 2250 feet in width with a mean width of 600 feet. When the single non-road crossing site at Indian Ridge was removed from this list, the mean crossing width dropped to 500 feet. The 17 crossing sites lay between 13 unfragmented blocks of land that were comprised of forestland and/or agricultural land.<sup>9</sup> These blocks ranged in size from 167 acres to 3077 acres with a mean size of 1083 acres *within* Lebanon, and 612 acres to 7836 acres with a mean size of 2250 acres when lands in adjacent towns were included.

Six of the 17 wildlife crossing sites were deemed to be the “best” crossing sites at the time of the survey:

- 1) **Rix Ledges – Etna Road**
- 2) **Town Line – Route 120**
- 3) **Great Brook Road – Meriden Road**
- 4) **Slayton Hill Road – Ticknor**
- 5) **Mount Support Road**
- 6) **Route 120**

These areas had the highest number of wildlife crossings by the greatest number of species, and/or provided connections to the largest unfragmented blocks of land in Lebanon and the surrounding towns. That said, some of these ‘best’ crossing areas presented severe challenges to migrating wildlife species due to the very high traffic volumes that have been estimated for these roadways. Route 120 topped this list due to the very wide crossing area (135 feet), the high number of AADT’s (22,000), and pressure from nearby development (i.e. DHMC-related businesses and the new PBP above the new Westin Element Hotel). Meriden Road had the least number of recorded AADT’s (2900), but also presented a relatively straight road with very high speeds (unlike Etna Road where sharp curves and a busy commercial-industrial frontage force people to slow down).

In each of these cases, improvements to facilitate wildlife crossing can be made. While these are detailed for each crossing area above, the two most common recommendations included the posting of suitable signage that alerts drivers to the increased likelihood of crossing animals, and the procurement of conservation protection for lands on either side of the crossing area. The latter is especially critical given the current pressure to develop some of these lands (e.g. along Etna Road), and the potential to offset development impacts by providing permanent green spaces for wildlife corridor use. Although designs for these need to be established on a case by case basis, a beginning point for guidance in this regard is the estimated width of the corridor itself along the roadway.

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<sup>9</sup> Buffer widths from development were set for each road type and development type according to established standards for wildlife resistance curves. See Lebanon NRI.

In sum, Lebanon has a tremendous diversity of wildlife habitat that supports all of the vertebrate wildlife species in the region. Its position between an arm of the Appalachian Mountain chain (Moose Mountain) and the Connecticut River gives it the unique advantage of providing corridors and connections between very diverse landscapes. While the riverine corridors have received a great deal of attention that now provide pathways for human and animal passage along the major rivers and streams, procuring the connections between unfragmented blocks of *upland* habitat has been less forthright. It is hoped that this study will help inform the city planning officials about those upland areas that currently provide pathways between large patches of undeveloped land. Whereas the 2013 study and the current study has focused on just 17 of the 65 wildlife crossing areas identified in the 2008-2010 NRI, it is apparent that these represent the most valuable potential additions to the “green infrastructure” that helps make Lebanon well-endowed with both human and wildlife residents alike. With good planning and further investments in the future of this green infrastructure, the wildlife populations of this city will continue to be able to travel easily between and among the high quality habitat areas upon which they depend.



**Mark Goodwin describing wildlife crossing area at Timberwood development during NHANRS wildlife corridors workshop**

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## **Appendix A**

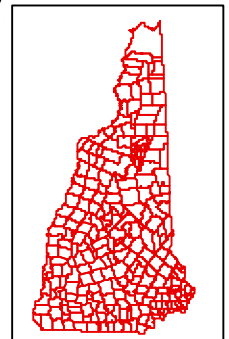
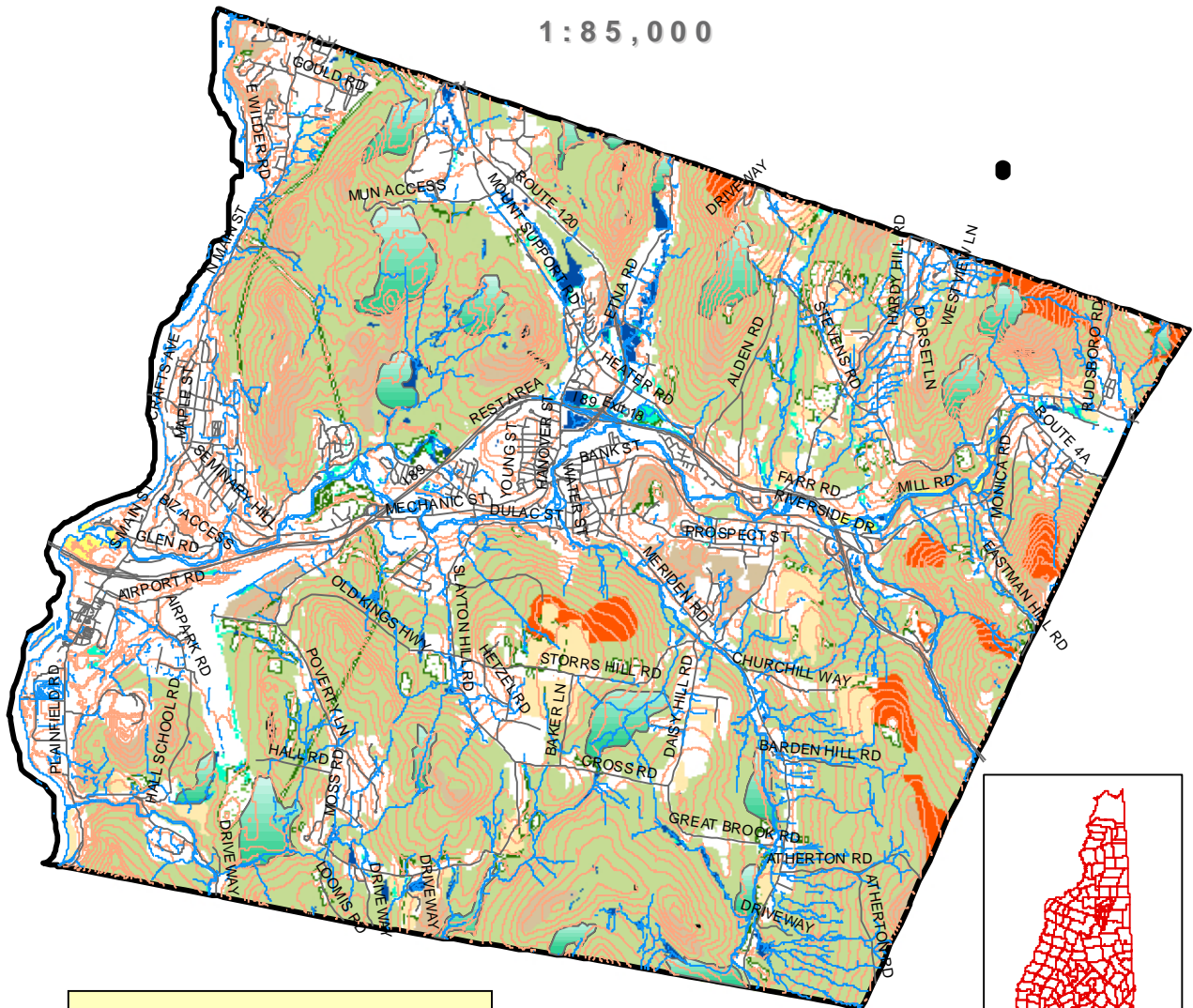
### **List of Maps**

<b>Wildlife Habitat Base Map</b>	<b>A – 1</b>
<b>Wildlife Action Plan Map</b>	<b>A – 2</b>
<b>Wildlife Species Observations Map</b>	<b>A – 3</b>
<b>Wildlife Crossings Map</b>	<b>A – 4</b>

# Wildlife Habitat Map of Lebanon NH

[Derived from Fieldwork & Aerial Photo Interpretation]

1:85,000

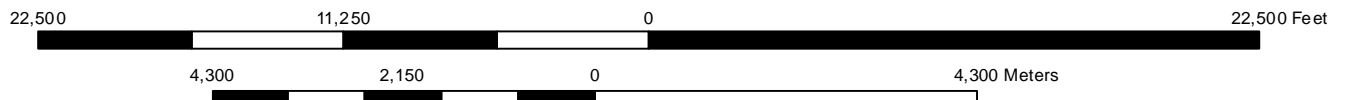


## Legend

- Stream/River
- Road Centerlines
- Peatlands
- Marshlands
- Floodplain Forests
- Grasslands > 10 acres
- Upland Scrub
- Rocky Ridge / Talus Slope
- Lowland Spruce-fir Forest
- Northern Hardwood-Conifer Forest
- Appalachian Oak-Pine Forest
- Hemlock-Hardwood Forest

## ABOUT THIS MAP

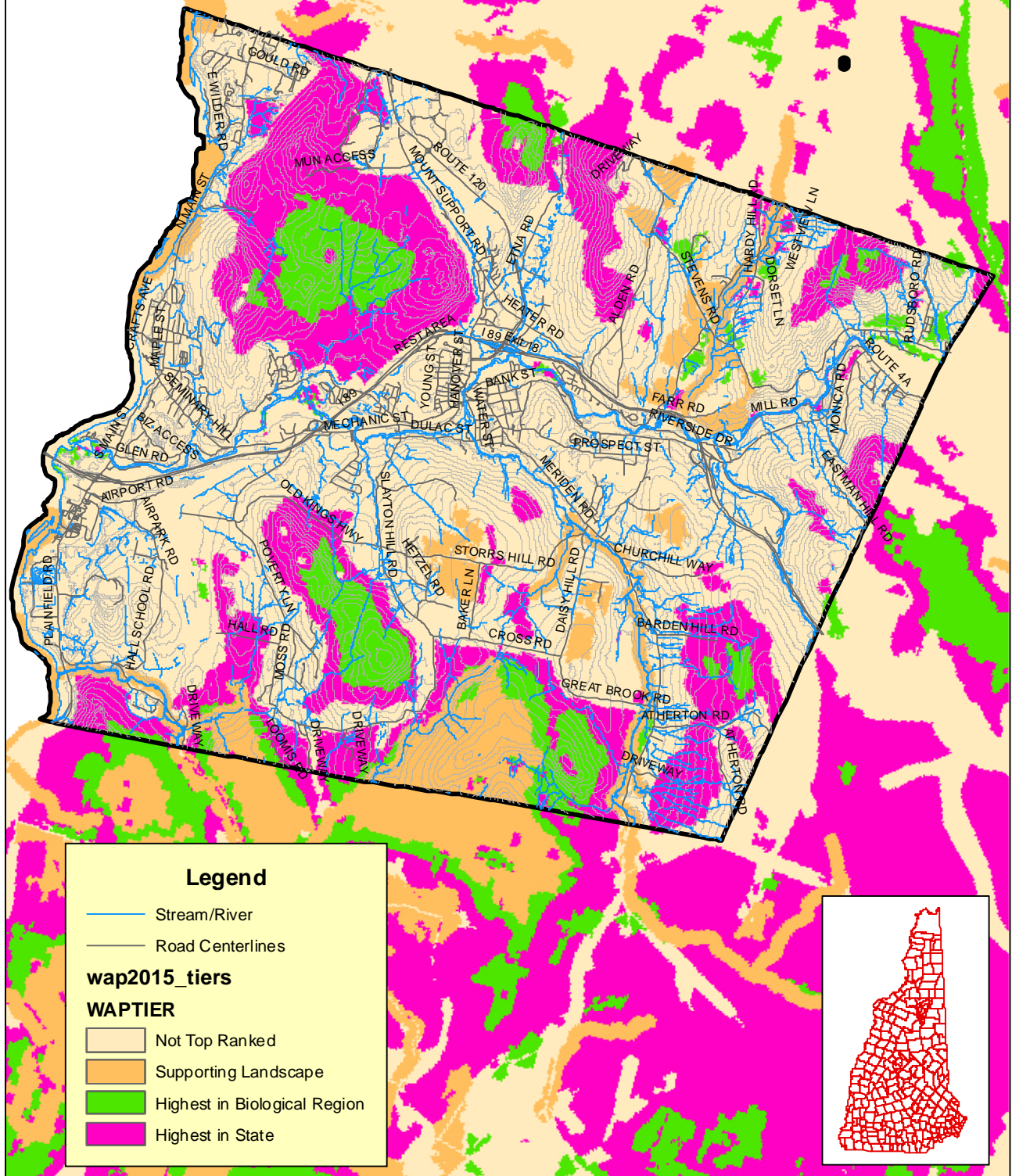
Wildlife habitat types were initially derived from the 2005 Wildlife Action Plan (WAP) courtesy of the NH Fish & Game Department and NH GRANIT. All eight WAP types were located in Lebanon, but were reconfigured based on field surveys. Two additional WAP types, Upland Scrub, and Rocky Ridge / Talus Slope were identified & mapped. All field data were GPS-based, using Garmin hand-held units with a precision of 4 - 10 m. Areas not covered by fieldwork were mapped according to the 2007 1-ft color aerial photographs supplied by the City Planning Department. Map not for survey purposes / EMC 1/10.



# Wildlife Action Plan Habitat Map

[Derived from the NH 2015 Wildlife Action Plan]

1:85,000



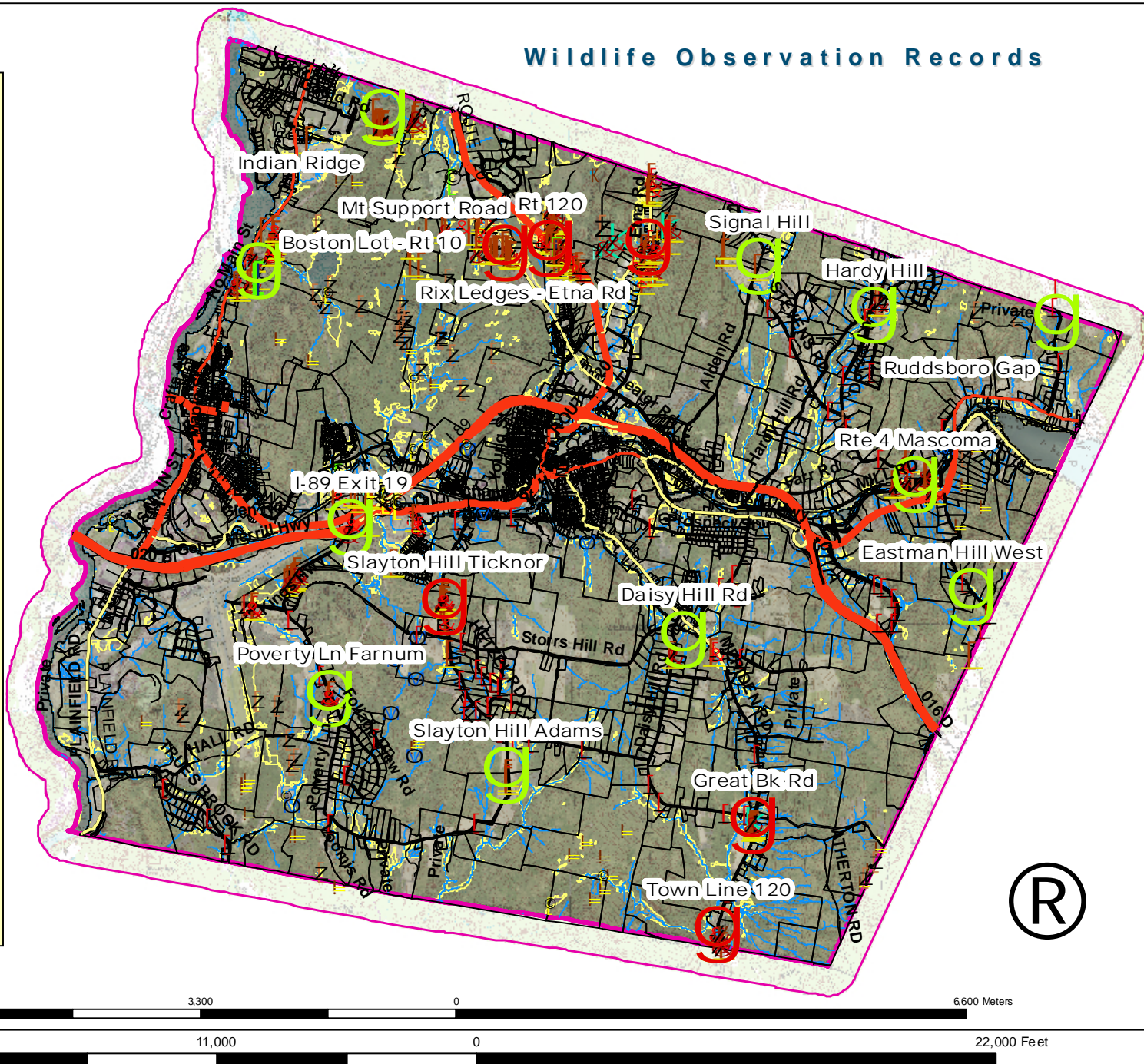
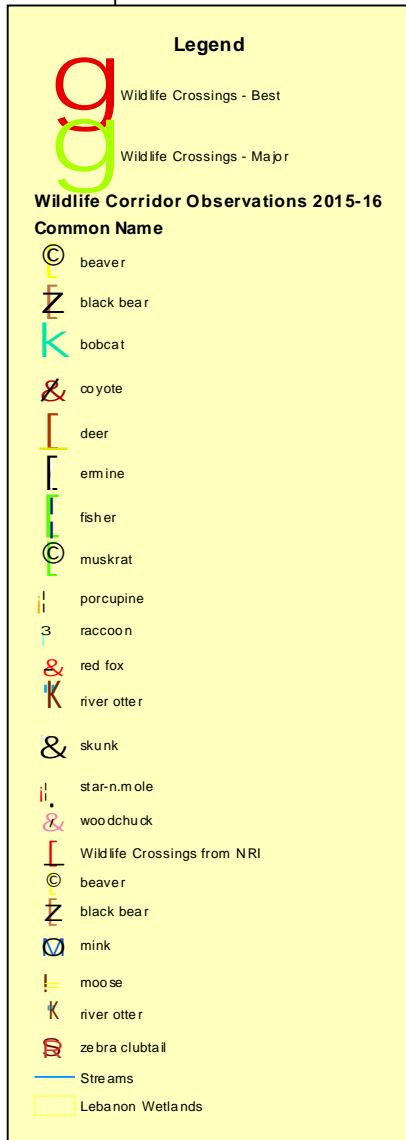
22,500 11,250 0 22,500 Feet

4,300 2,150 0 4,300 Meters

# Lebanon Wildlife Corridor Analysis

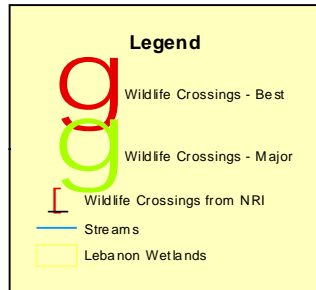
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## Wildlife Observation Records

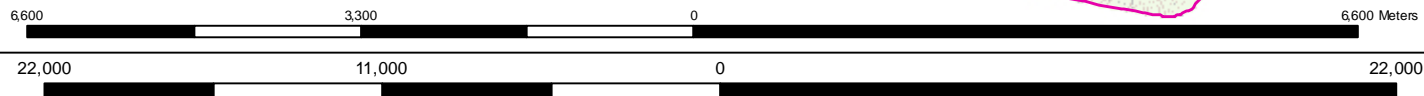
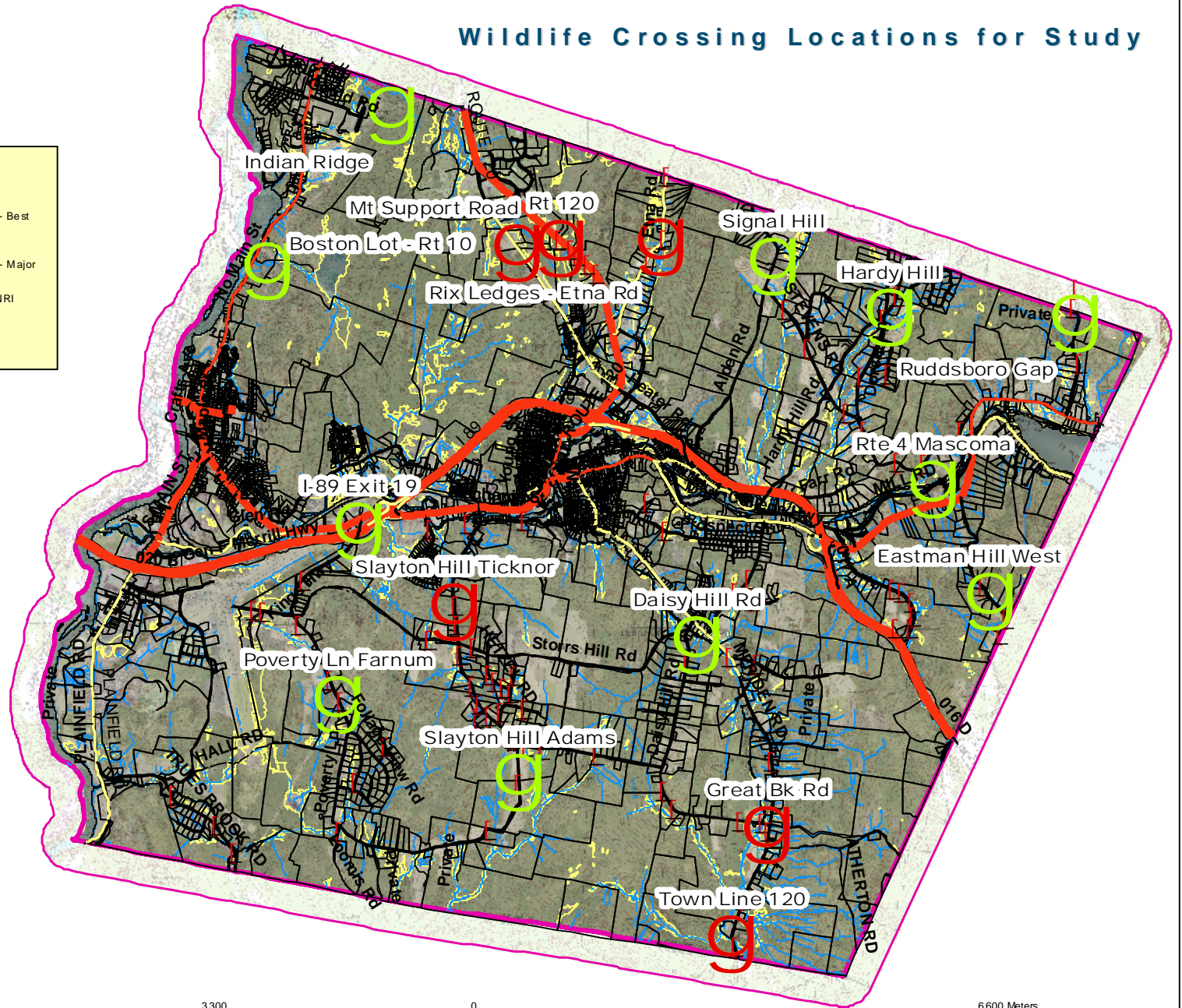


1:75,000

# Lebanon Wildlife Corridor Analysis



## Wildlife Crossing Locations for Study



## **Appendix B**

### **PHOTOS OF WILDLIFE CROSSING AREAS**



File Name : 001 rip-rap at edge Westin Element Rt 120.JPG  
Shooting Date/Time : 11/14/2014 12:00:37 PM



File Name : 002 deer gallop in at south crossing locale Rt 120.JPG  
Shooting Date/Time : 3/24/2015 11:51:47 AM



File Name : 01 old road at south Rt 120 crossing site.JPG  
Shooting Date/Time : 3/24/2015 11:22:55 AM



File Name : 02 the 3-foot culvert underpass east side Rt 120.JPG  
Shooting Date/Time : 3/24/2015 11:26:26 AM



File Name : 03 week-old deer carcass at the north crossing Rt 120.JPG  
Shooting Date/Time : 3/24/2015 11:10:20 AM



File Name : 04 bear trail past bite tree along Rt 120.JPG  
Shooting Date/Time : 4/25/2013 4:38:28 PM



File Name : 05 Timberwood fence at Mt  
Support Rd x-ing.JPG  
Shooting Date/Time : 3/24/2015 12:50:50 PM



File Name : 06 Mt. Support Rd x-ing area  
and riprap.JPG  
Shooting Date/Time : 4/4/2013 3:17:28 PM



File Name : 07 lkg E along I-89 at Poverty Ln.JPG  
Shooting Date/Time : 4/4/2013 2:38:23 PM



File Name : 08 I-89 underpass behind Granite St Glass.JPG  
Shooting Date/Time : 4/25/2013 9:34:34 AM



File Name : 09 Indian Ridge deer trail above powerline near Sachem V  
Shooting Date/Time : 1/27/2016 11:52:18 AM



File Name : 10 deer tracks along old beaver meadow Indian Ridge E.J  
Shooting Date/Time : 1/27/2016 12:55:01 PM



File Name : 11 main game trail down to x-  
-ing above canoe portage GPS  
Shooting Date/Time : 1/27/2016 2:41:45 PM



File Name : 12 deer goes for a swim near  
canoe portage.JPG  
Shooting Date/Time : 5/27/2015 4:22:04 PM



File Name : 13 best x-ing area Etna Rd R-  
ix - Campion.JPG  
Shooting Date/Time : 10/1/2015 12:02:41 PM



File Name : 14 lkg back along Etna Rd at  
x-ing area.JPG  
Shooting Date/Time : 10/1/2015 12:04:46 PM



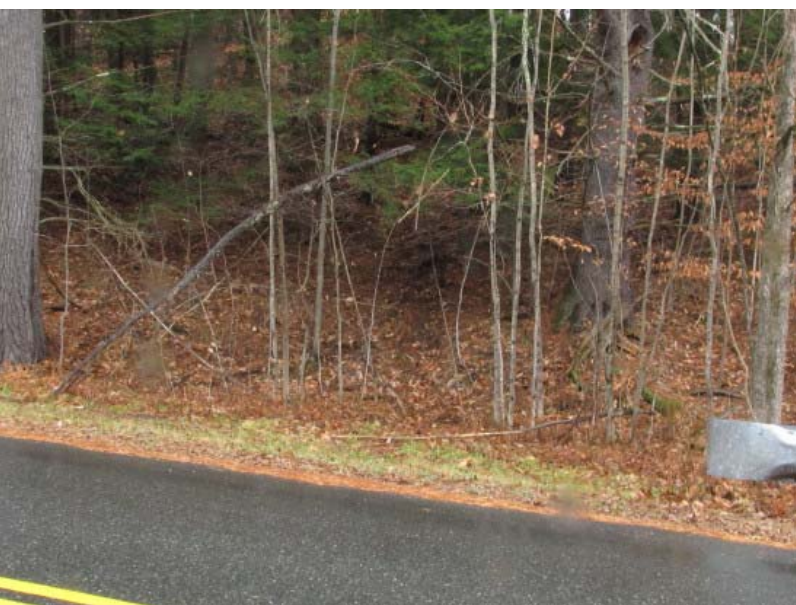
File Name : 15 beaver marsh x-ing area  
Etna Rd.JPG  
Shooting Date/Time : 10/1/2015 12:04:04 PM



File Name : 16 view SE from Rix Ledges-  
.JPG  
Shooting Date/Time : 3/4/2016 11:41:11 AM



File Name : 17 Signal Hill fields lkg across the Eagle Ridge.JPG  
Shooting Date/Time : 10/1/2015 2:01:25 PM



File Name : 18 well-defined trail Brook Rd Hardy Hill x-ing.JPG  
Shooting Date/Time : 11/12/2015 3:14:48 PM



File Name : 19 E. Mt. Tug int. str. at crossing site.jpg  
Shooting Date/Time : 3/26/2006 7:45:14 AM



File Name : 20 Mascoma bend x-ing area  
GPS#116.JPG  
Shooting Date/Time : 11/12/2015 1:31:52 PM



File Name : 21 jct RR grade at 2nd Mas-  
coma R bridge w-trail adj..JPG  
Shooting Date/Time : 11/12/2015 1:48:17 PM



File Name : 22 x-ing area Eastman Hill  
West GPS #109.JPG  
Shooting Date/Time : 11/12/2015 1:04:31 PM



File Name : 23 Daisy Hill Rd Ov-Cl x-ing  
into meadow GPS#80.JPG  
Shooting Date/Time : 1/27/2016 4:02:09 PM



File Name : 24 opp. side Daisy Hill Rd G-  
PS#80.JPG  
Shooting Date/Time : 1/27/2016 4:02:13 PM



File Name : 25 mink culvert use of Great  
Bk Rd culvert.jpg  
Shooting Date/Time : 3/10/2006 10:46:21 AM



File Name : 26 town line rt 120 x-ing area  
Meriden Rd.JPG  
Shooting Date/Time : 1/27/2016 4:38:15 PM



File Name : 27 main game trail x-ing at  
Town Line.JPG  
Shooting Date/Time : 1/27/2016 4:46:21 PM



File Name : 28 Ov x-ing Slayton Hill Rd -  
Adams.JPG  
Shooting Date/Time : 1/27/2016 10:48:02 AM



File Name : 29 Ascutney View Farm activity GPS#23.JPG  
Shooting Date/Time : 1/27/2016 10:50:19 AM



File Name : 30 powerline x-ing Poverty Ln w- trails GPS#21.JPG  
Shooting Date/Time : 1/27/2016 10:07:41 AM



File Name : 31 Ov-CI-Vv x-ing Poverty Ln  
near powerline.JPG  
Shooting Date/Time : 1/27/2016 10:07:48 AM



File Name : 32 more x-ings at GPS#30 S-  
layton-Ticknor.JPG  
Shooting Date/Time : 1/27/2016 11:16:15 AM